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Instruction Manual

MODEL

8375A

DIGITAL VOLTMETER

FLUKE

JOHN FLUKE mfg. co., inc.

SEATTLE, WASHINGTON

GENERAL ELECTRIC

INSTRUMENTATION & CONTROL SERVICE

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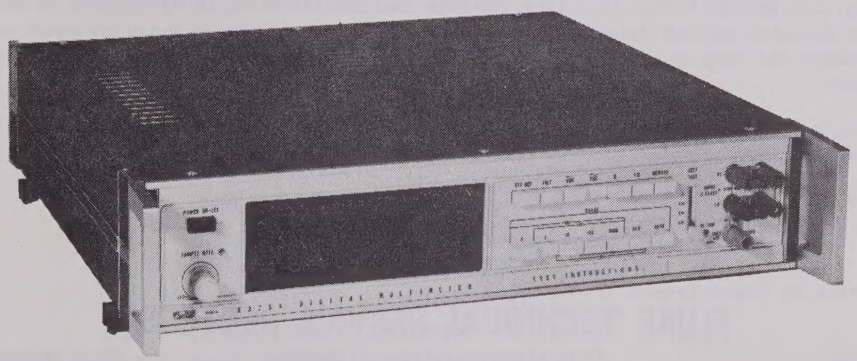

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DIGITAL VOLTMETER

OCTOBER 1973

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1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

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The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P. O. Box 7428, SEATTLE, WASHINGTON 98133*.

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 8375A is a versatile digital multimeter with five full decades of digits plus a sixth digit for 20% overrange. The instrument offers five ranges of dc voltage measurement including autorange, autopolarity, and switchable active filtering. Four ranges of true rms ac voltage measurement and seven ranges of resistance measurement are also included.

1-3. Fluke's Recirculating-Remainder A/D conversion technique is used in the 8375A. This conversion circuitry periodically samples the input and serially digitizes the sample, providing a reliable instrument with high long-term accuracy and linearity plus superior environmental characteristics.

1-4. DC voltages are measured on five ranges with up to one microvolt of resolution. Overranging of 20% with 1100 volt overload capability further characterizes these ranges. A non-blinking readout contains an in-line readout tube display showing polarity, overrange digit, and five full decades of digits followed by a lighted function annuciator. The speed at which the readout updates is controlled by a sample rate control.

1-5. True-rms ac voltages to 1100 volts are measured on four ranges over a frequency domain of 10 Hz to 100 kHz with up to 10 microvolts resolution. Also, proper measurement of waveforms with high distortion and high crest factor characteristics can be made with this true-rms converter.

1-6. True four-terminal resistance measurements on the 10-ohm through 10K-ohm ranges are made with low power dissipation in the unknown resistor. The instrument autoranges through all resistance ranges, from 10 ohms to 10 megohms, with up to 100 microohms resolution.

1-7. Pushbutton selection, 1000-volt guarding, full autoranging, instantaneous auto-polarity, and calibration of all functions through the top guard cover are standard features of the 8375A.

1-8. Isolated four-terminal DC/DC ratios are measured in real time via the DC External Reference option. The Reference input LO terminal may be elevated by as much as $\pm$13V from the input LO terminal without loss of ratio accuracy. Furthermore, the standard reference voltage span of +1V to +10.5V permits measurement of ratios from a wide number of sources. Special reference voltage ranges are available on request.

1-9. Isolated Data Output and Isolated Remote Control options use guarded toroids to transfer data and commands to and from the 8375A with no degradation of common-mode rejection specifications. These options are also DTL/TTL compatible and are designed to permit multiplexing of several 8375A's on common sets of control and data output lines. Moreover, they are buffered to prevent interaction between the DMM and the acquisition/control devices.

1-10. External Triggering of the 8375A is accomplished via its Data Output Unit, and resulting data may be acquired fully in parallel BCD format or serially by character in multiples of four bits. A single control line enables automatic time delays that allow for full settling of the analog input prior to digitization of the data transferred. Five flags provide continuous measurement status information for the acquisition device.

1-11. Remote Control is exerted by contact closures or logic levels. The 8375A's Control Command Storage feature permits the 8375A to latch on commands, which may be later removed from inputs while the 8375A retains the commanded function and range in internal memory.

1-12. SPECIFICATIONS

DC VOLTS

RANGES . . . . . ±0.1V, ±1V, ±10V, ±100V, ±1000V (automatic polarity selection)

Note: The 8375A will autorange through all voltage ranges.

Resolution . . . . . ±0.001% of range, (1μV maximum on ±0.1V range)

Overrange . . . . . 20%, ±1100V maximum input on ±1000V range

Overload . . . . . ±1100V DC or RMS (±1500V peak) may be continuously applied to any range without damage

ACCURACY (To 120% of range or ±1100V maximum input)

24 hours (23°C ± 1°C)	±10V, ±100V, ±1000V ranges	±(0.002% of input + 0.001% of range)
	±1V range	±(0.003% of input + 0.002% of range)
	±0.1V range	±(0.003% of input + 0.005% of range)
90 days (18°C to 28°C)	±10V, ±100V, ±1000V ranges	±(0.004% of input + 0.001% of range)
	±1V range	±(0.005% of input + 0.002% of range)
	±0.1V range	±(0.005% of input + 0.005% of range)
1 year (18°C to 28°C)	±10V, ±100V, ±1000V ranges	±(0.01% of input + 0.001% of range)
	±1V range	±(0.02% of input + 0.002% of range)
	±0.1V range	±(0.02% of input + 0.005% of range)

Temperature Coefficients (0°C to 18°C and 28°C to 50°C)

±10V, ±100V, ±1000V ranges	±(0.0003% of input + 0.0001% of range)/°C
±1V range	±(0.0004% of input + 0.0002% of range)/°C
±0.1V range	±(0.0005% of input + 0.0006% of range)/°C

Input Impedances	±10V range	10,000 megohms
	±1V range	1000 megohms
	±0.1V range	100 megohms
	±100V, ±1000V range .	10 megohms

shunted by less than 100 p.f.

Offset Current at 23°C ± 1°C . . . . . Less than ±5 pa. on any range.

Temperature Coefficient . . . . . Less than ±1 pa./°C on any range

Zero Stability . . . . . Better than 5μV for 90 days after a one hour warmup

NOISE REJECTION

Normal Mode (filtered) . . . . . Greater than 65 db @ 60 Hz (60 db @ 50 Hz)

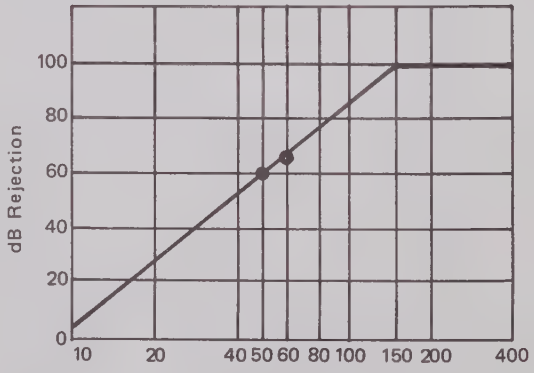
Maximum superimposed AC Voltage . . . 50% of range peak AC, maximum

NOTE: The Normal Mode and Common Mode Rejection are not 60 Hz harmonic oriented due to the broadband response of the active 4 pole filter (80 db per decade attenuation) and therefore will reject random noise at any frequency.

Common Mode (with up to 1K unbalance in either lead)

DC		Greater than 140 db
AC to 60 Hz,	Filter "in"	Greater than 140 db
	Filter "out"	Greater than 100 db

Typical 8375A, Normal Mode Noise Rejection, Filter In.



The Fluke 8375A is not dependent on 60 Hz harmonics and therefore will reject random noise at any frequency. The same applies to Common Mode Rejection.

NOTE: Common Mode Rejection specifications are maintained with any combination of options installed and are unaffected when grounded devices are used in conjunction with the remote control or data output options.

RESPONSE TIME (from an input step change to a completed reading within 0.005% of the change when externally triggered)

Filter "out" . . . . . Less than 33 milliseconds, 100 milliseconds on 0.1V range
Filter "in" . . . . . 500 milliseconds

TRUE RMS AC VOLTS

For Measurement of DC-Coupled (AC+DC) Voltages or AC-Coupled (AC only)[3]

RANGES . . . . . 1, 10, 100, 1000 VAC
Overrange . . . . . 20%, 1100V RMS maximum on 1000V range
Resolution . . . . . 0.001% range (10μV on 1V range)
Overload . . . . . 1100V RMS any range (1500V peak AC)
Superimposed DC (AC only) . . . . . 1100V DC (Peak AC plus DC may not exceed ± 1500V)
Max. Crest Factor . . . . . 7 at full-scale and increasing down scale per: $7X\sqrt{\frac{V\ Range}{V\ Input}}$

ACCURACY SPECIFICATIONS 23°C ± 5°C, 0.001V - 1100V *(2)* **± (% of input + % of range)**

	AC + DC (90 days)	AC Only (90 days)	AC + DC (1 year)	AC Only (1 year)
DC	± (0.1 + 0.03)		± (0.13 + 0.07)	
10Hz-20Hz	± (1.0 + 0.06)	± (1.0 + 0.04)	± (1.3 + 0.1)	± (1.3 + 0.06)
20Hz-50Hz	± (0.5 + 0.03)	± (0.5 + 0.012)	± (0.65 + 0.07)	± (0.65 + 0.032)
50Hz-10kHz *(1)*	± (0.1 + 0.03)	± (0.1 + 0.02)	± (0.13 + 0.07)	± (0.13 + 0.04)
10kHz-30kHz	± (0.2 + 0.06)	± (0.2 + 0.04)	± (0.26 + 0.1)	± (0.26 + 0.06)
30kHz-50kHz	± (0.3 + 0.12)	± (0.3 + 0.1)	± (0.39 + 0.16)	± (0.39 + 0.12)
50kHz-100kHz	± (1.5 + 0.4)	± (1.5 + 0.4)	± (1.95 + 0.4)	± (1.95 + 0.4)
100kHz-300kHz	± (4.0 + 1.0)	± (4.0 + 1.0)	± (5.0 + 1.0)	± (5.0 + 1.0)
Temperature Coefficients *(3)*	± (0.004 + 0.004) /°C	± (0.004 + 0.001) /°C	± (0.004 + 0.004) /°C	± (0.004 + 0.001) /°C

(1) With inputs above 500V multiply accuracy by $\left[\frac{2000V + V\ input}{2000V}\right]$ *(3) 0°C to 50°C, to 10KHz*

(2) Input volt x hertz, product should not exceed 2 x 10^7

Temperature Coefficients (0°C to 18°C and 28°C to 50°C)
DC and 10 Hz - 10 kHz (AC + DC) . . ±(0.004% Inp. +0.004% Range)
10 Hz - 10 kHz (AC only) . . . . . ±(0.004% Inp. + 0.001% Range)
Input Impedance . . . . . 1 Megohm, shunted by less than 150 pf.

NOISE REJECTION

Common Mode (with up to 100Ω unbalance in either lead)
DC to 60 Hz . . . . . Greater than 120 db

RESPONSE TIME (to a reading withing 0.1% of range when measuring step change inputs and using external trigger)

Filter "out" . . . . . 100 milliseconds maximum[4]
Filter "in" . . . . . 500 milliseconds maximum
(For readings less than 10% Range, double indicated times).

(4) Above 400Hz for rated accuracies.

RESISTANCE

RANGES 10Ω, 100Ω, 1000Ω, 10,000Ω, 100KΩ, 1000KΩ, 10,000KΩ
NOTE: Model 8375A will autorange through all resistance ranges.
Resolution . . . . . 0.001% of range, (100uΩ maximum on 10Ω range)
Overrange . . . . . 20%, 12 megohms maximum on 10,000K range
Overload, 10Ω - 10,000Ω ranges . . . . 20V RMS (fused-spare supplied)
100KΩ - 10,000KΩ ranges . . . . Up to 250V RMS may be continuously applied without damage.

ACCURACY (To 120% of range)

90 Days, (18°C to 28°C)	100kΩ - 1000kΩ ranges	±(0.01% of input + 0.002% of range)
	100Ω - 10,000Ω ranges	±(0.01% of input + 0.003% of range)
	10Ω range	±(0.01% of input + 0.01% of range)
	10,000kΩ range	±(0.05% of input + 0.002% of range)
Temperature Coefficients (0° to 18°C and 28° to 50°C)		
	100kΩ, 1000kΩ ranges	±(0.0007% of input + 0.0001% of range)/°C
	10,000kΩ range	±(0.003% of input + 0.0001% of range)/°C
	100Ω - 10,000Ω ranges	±(0.001% of input + 0.0002% of range)/°C
	10Ω range	±(0.001% of input + 0.0005% of range)/°C

CONFIGURATION . . . . . True 4-terminal through 10,000Ω range and 2 terminal on the 100KΩ through 10,000KΩ ranges.

Current through R measured

Range	10Ω,	100Ω,	1000Ω,	10,000Ω,	100KΩ,	1000KΩ, 10,000KΩ
Current	10 ma	1 ma	100 μa	10 μa	1 μa	

Maximum Lead Resistance (for less than 0.001% of range effect on accuracy)

4 terminal mode, Current Leads		10Ω in both leads on 10Ω range and 100Ω on all other ranges
	Voltage Leads	1 KΩ in either lead on all ranges
2 terminal mode		Less than 0.001% of range lead resistance

RESPONSE TIME (From an input step change to a completed reading within 0.01% of the change when externally triggered)

Filter "out"	33 milliseconds, 100 milliseconds on 10Ω range
Filter "in"	500 milliseconds

GENERAL

Total Digitizing Time		18 milliseconds
Sample Aperture		3 milliseconds
Autozero		3 milliseconds
Sample Rate		Up to 30 readings per second, when externally triggered via Data Output Option, 8375A-03. Manually variable from 13 per second to one per 4.5 seconds via front panel sample rate control.
Autorange Time Filter "out"		50 milliseconds per range change
	Filter "in"	280 milliseconds per range change
Filter		4-pole active filter for use with DC volts, AC volts, and Resistance measurements
Range Selection		Manual, Automatic Standard; Remote Optional
Function Selection		Manual Standard, Remote Optional, Autoranges from Ω to KΩ
Display		In-line neon-tube display of polarity, overrange digit and 5 full decades of digits, with automatic decimal placement plus an illuminated function annunciator.

Overload Limits (maximum voltage that may be continuously applied without damage)

"Hi" to "Lo"		See individual function under "range", & "overload"
"Lo" to "Guard"		±100V DC or peak AC
"Guard" to "Chassis"		±1000V DC or peak AC maximum Common Mode Voltage
Temperature Range, Operating		0°C to +50°C
	Non-Operating	−40°C to +75°C
Humidity Range	0°C to +25°C	Less than 80% relative Humidity
	+25°C to +50°C	Less than 70% relative Humidity
Altitude Range	Operating	To 10,000 feet (3,048 kM)
	Non-Operating	To 50,000 feet (15,25 kM)
Shock and Vibration		Meets requirements of MIL-T-21200H and MIL-E-16400F
Operating Power (including options)		115/230 VAC ± 10%, 50 to 440 Hz, Less than 25W

Weight (including Options)	Less than 20 pounds (9.08 kg)
Size	3½" H x 17" W x 18" D (88, 1 mm x 432 mm x 457, 4 mm)
Warm-up Time	20 minutes to 1 year accuracy, 1 hour to full accuracy
MTBF	10,000 hours

ISOLATED DATA OUTPUT (Using Option 8375A-03)

NOTE: Two mating connectors are supplied.

Data Available	Digits, polarity, range, functions
Coding	8 4 2 1 BCD, digits and range
Logic Levels	1 = +5V, 0 = 0V (Series 930 DTL with 6K pullup)
Maximum Trigger Rate	30 per second
Flags	Digitizing, Remotely Controlled, Remotely Triggered, Busy, Overload, Sample Sync
Acquisition	Full parallel or serial by character in multiples of 4 bits
Automatic Adaptive Timeouts	Automatic delays to allow for settling time of all analog inputs are enabled via a single logic input line

ISOLATED REMOTE CONTROL (Using Option 8375A-04)

NOTE: Mating connector is supplied.

Control Levels	0 = function call, 1 = function inactive
Logic Levels	0 = Contact closure or 0V, 1 = open or +5V
Input Definition	Series 930 DTL
Control Command Storage	Continuous or addressed remote control of instrument. Triggered address control allows the 8375A to "latch" to input commands. Following latch, the commands may be removed but the functions and ranges commanded will continue to be in effect until the next address trigger.
Interlocks	Incompatible function or simultaneous ranges cannot be called.
No Call	Volts DC and autorange called
Flag	Remotely control Flag in Data Output Unit

NOTE: Requires +5V power (150mA) from Data Output Unit or external power supply which can be supplied as a special item. Contact factory for further details.

ISOLATED DC EXTERNAL REFERENCE (4-Wire DC/DC Ratio using Options 8375A-05 and 8375A-07)

NOTE: Mating connector is supplied.

REFERENCE INPUT

Type	True 4-Wire, Real Time
Voltage Range	+1V to +10.5V
Input Resistance	1 megohm ±0.1%
Isolation of Reference and Input Commons *NOTE: Fused to prevent damage.*	Input Hi to Reference Lo difference not to exceed ±13V on 10V and lower DC Voltage ranges

RATIO RANGES

	±0.01:1, ±0.1:1, ±1:1, ±10:1, ±100:1
Resolution	±0.001% of DC Voltage range, (0.000001: 1 maximum on ±0.01: 1 ratio range)
Overrange	20%, 110: 1 maximum input on 100: 1 range

NOTE: $\frac{\%\ \text{Input Voltage Range}}{\%\ \text{Reference Voltage Range}}$ *must be less than 1.2 for a non-overrange reading.*

Overload	±1100V DC or RMS (±1500V peak) may be continusously applied to the numerator (input) terminals without damage.
Reading vs. Ratio	10 x Ratio

ACCURACY (To 120% of ratio range)

90 days (18°C to 28°C)	±1:1, ±10:1, ±100:1 ratio ranges	±(0.005% of Reading + 0.002% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)
	±0.1:1 ratio range	±(0.005% of Reading + 0.004% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)
	±0.01:1 ratio range	±(0.005% of Reading + 0.01% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)

NOTE: 24 hour and 1 year specifications available upon request.

Temperature Coefficients (0°C to 18°C and 28°C to 50°C)

±1:1, ±10:1, ±100:1 ratio ranges.	±(0.0003% of Reading + 0.0001% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)/°C
±0.1:1 ratio range	±(0.0004% of Reading + 0.0002% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)/°C
±0.01:1 ratio range	±(0.0005% of Reading + 0.0006% x $\left(\frac{10V}{Vref}\right)$ of DC Voltage range)/°C

NOISE REJECTION (At Reference Input)

Normal Mode	30 db @ 60 Hz
Common Mode (with up to 1K unbalance) . . .	120 db with a +10V Reference

REFERENCE SETTLING TIME . . . . . 2 seconds

(To 0.01% of range following a step change of reference voltage. Numerator response time same as "dc volts".)

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating instructions for the Model 8375A Digital Multimeter. If any problem is encountered in operating the instrument, contact the nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co., Inc. Please include the instrument serial number when writing.

2-3. INSTALLATION

2-4. The 8375A is supplied with non-marring feet and tilt-down bail for bench or field use. A rack-mounting kit and rack-slide kits for installation of the instrument in a standard 19-inch rack are available. These accessories are described in Section 6 of the manual.

2-5. REPACKAGING FOR SHIPMENT

2-6. This instrument was packed and shipped in a foam-packed cardboard carton. If reshipment is required, use the original container or request a new container from the John Fluke Mfg. Co., Inc. Please include instrument model number with your request.

2-7. OPTIONS AND ACCESSORIES

2-8. Model 8375A options and accessories are listed in Table 2-1. They are fully described in Section 6 of the manual.

Table 2-1. OPTIONS AND ACCESSORIES

OPTION NO.	NAME
8375A–03	Data Output
8375A–04	Remote Control
8375A–05	External Reference
8375A–07	Rear Input
ACCESSORY NO.	**NAME**
298265	Extender Assembly (Required for servicing pcb's)
M03-205-600	Rack Ears
M00-260-610	18-in. Rack Slides
M00-280-610	24-in. Rack Slides
A90	Current Shunts
80F-5	High Voltage Probe
80F-15	High Voltage Probe
80 RF	High Frequency Probe

2-9. INPUT POWER REQUIREMENTS

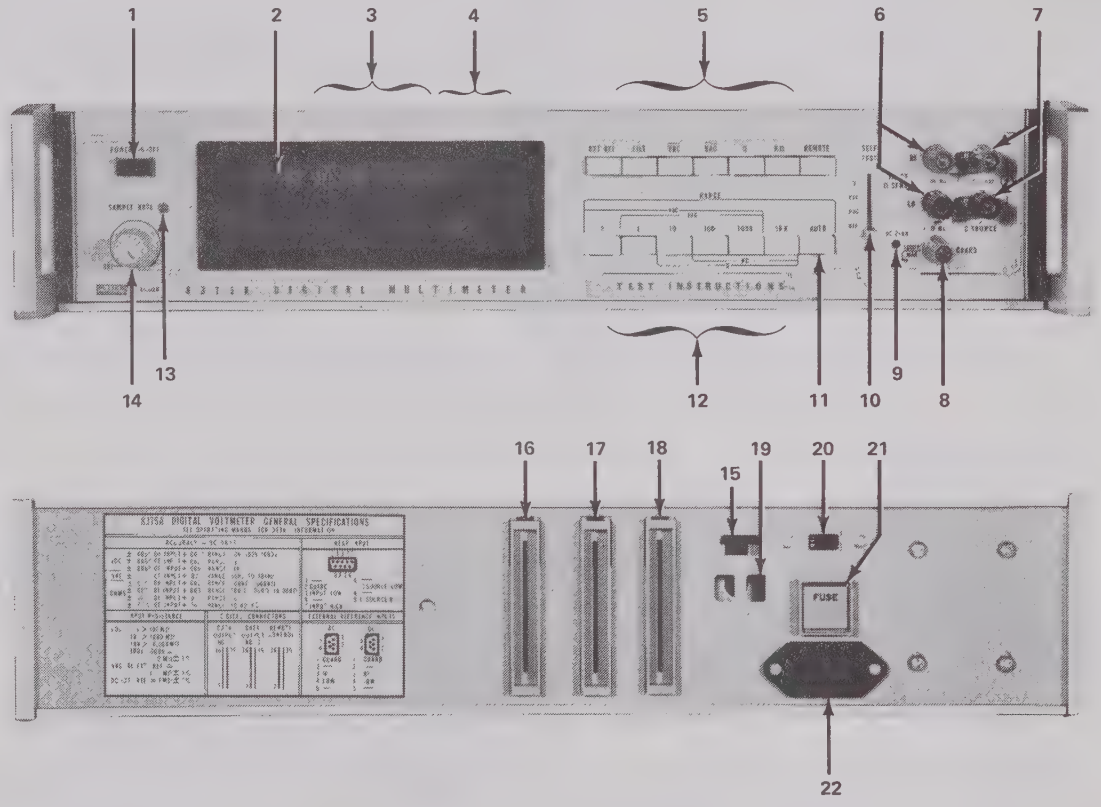
2-10. The 8375A operates on 115 or 230 volts, 50 Hz to 440 Hz ac power. Before applying power to the instrument, note the position of the 115/230 volt slide switch at the rear of the instrument (Figure 2-1). If the switch does not indicate the desired operating voltage, place it in the correct position.

WARNING!

Ensure that the instrument case is connected to a high quality earth ground, either through the polarized line plug or through a separately connected ground wire.

2-11. OPERATING FEATURES

2-12. The name and function of front and rear panel controls, terminals and indicators are shown in Figure 2-1.



REF. NO.	NAME	FUNCTION
1	POWER Switch	Controls application of input power.
2	Polarity Indicator	Automatic indication of input polarity for dc voltage: "+" for positive input voltages and "—" for negative input voltages.
3	Readout Tubes	Display DMM readout from left to right, with overrange digit displayed in left-most tube. All tubes display a decimal point, depending on range. Full overrange readout on each range would appear as follows: RANGE — READOUT .1 — .119999 1 — 1.19999 10 — 11.9999 100 — 119.999 1000 — 1199.99 10K — 11999.9

Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 3)

REF. NO.	NAME	FUNCTION
4	Function/Status Annunciator	Indicate instrument function and status as follows: KΩ . . . . DMM operating in kilohm mode. AC . . . . DMM operating in ac voltage mode. DC . . . . DMM operating in dc voltage mode. Ω . . . . DMM operating in ohms mode. X REF . . . DMM operating in External Reference mode. FILT . . . . Active 4-pole filter called for maximum noise rejection. OVER. . . . DMM input is over the 20% overrange capability.
5	FUNCTION Switches	Select desired DMM operating mode: EXT REF. . . Enables substitution of isolated external reference voltage for internal reference. FILT . . . . Controls 4-pole active input filter to provide desired noise rejection. Functional for dc voltage, ac voltage, and resistance measurements. VDC . . . . Places DMM in dc voltage mode with full-scale ranges of .1,1, 10, 100 and 1000. VAC . . . . Places DMM in ac voltage mode with full-scale ranges of 1, 10, 100 and 1000. Ω . . . . Places DMM in ohms mode with full-scale ranges of 10, 100, 1000 and 10K if available range is called; otherwise, DMM autofunctions to KΩ. KΩ . . . . Places DMM in kilohms mode with full-scale ranges of 100, 1000 and 10K if available range is called; otherwise, DMM autofunctions to Ω. REMOTE. . . Places DMM in remote mode, enabling DMM function and range to be controlled remotely via the Remote Control Unit.
6	INPUT Terminals	HI, LO input connections for dc and ac voltage measurement.
7	ΩSOURCE Terminals	Current source for all resistance measurements.
8	GD (Guard) Terminal	Connects to internal guard chassis. When properly connected externally, provides maximum common mode rejection.
9	DC ZERO Control	Adjusted for .000000 ± 1 with VDC, Filter, and .1 Range called and INPUT terminals shorted.
10	TEST Switch	Permits self-test of instrument in VDC, VAC, and OHMS modes.
11	AUTO RANGE Switch	Places instrument in autorange mode, providing automatic ranging for each function and its range complement.

Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 3)

REF. NO.	NAME	FUNCTION
12	Manual RANGE	Enable manual selection of range. Not calling a range or incorrect range selection automatically places DMM in autorange mode.
13	Sample Rate Indicator	Visual indication of sample rate.
14	SAMPLE RATE Control	Permits variation of sample rate from 13 readings per second to 1 reading per 4.5 seconds. In EXT position (fully counterclockwise), sample rate control is transferred to remote control point via the Data Output Unit. If the Data Output option is not installed and the control is turned to EXT, the instrument will read out and display from its internal storage circuitry indefinitely, with readout corresponding to value of last measurement sample.
15	Rear Input Connector	Provides connections for rear input to instrument (Option –07).
16	Data Output Unit Connector (No. 1)	Provides connections for Data Output Unit (Option –03).
17	Data Output Unit Connector (No. 2)	Provides connections for Data Output Unit (Option –03).
18	Remote Control Connector	Provides connections for Remote Control (Option –04).
19	DC External Reference Connector	Provides connections for DC External Reference Unit (Option –05).
20	115/230 Volt Input Power Switch	Selects either 115 or 230 volt ac line operation.
21	Line FUSE	Protects instrument from overloads. Fuse rating is AGC ½ ampere.
23	AC Line Voltage Connector	Mates with polarized 3-wire power cord for connection to 115/230 volt, 50 Hz to 440 Hz, ac line.

Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS (Sheet 3 of 3)

2-13. TEST SWITCH OPERATION

2-14. Information for operation of the TEST switch is given in Table 2-2. For each position of the TEST switch, perform the following:

1. Depress FUNCTION switch.
2. Depress "100" RANGE switch.
3. Select TEST switch position.
4. Observe readout according to Table 2-2.

Table 2-2. TEST SWITCH OPERATION

TEST SWITCH POSITION	FUNCTION SWITCH	INSTRUMENT READOUT
OFF	—	—
VDC	VDC	20.000 ± .100
VAC	VAC	13.000 ± 2.000
Ω	Ω	100.000 ± .200

2-15. MEASUREMENT INSTRUCTIONS

2-16. Measurement instructions for basic DMM functions are given in Table 2-3.

Table 2-3. 8375A MEASUREMENT INSTRUCTIONS

MEASUREMENT	8375A			REMARKS
	FUNCTION	RANGE	INPUT CONNECTIONS	
±DC Voltage	VDC	.1, 1, 10, 100, 1000, AUTO	Front panel HI, LO terminals or rear input terminals if equipped with Rear Input option.	Instrument autoranges automatically if range is not manually called or if a range is called that is not compatible with the selected function.
AC Voltage	VAC	1, 10, 100, 1000, AUTO		Use four-terminal ohms measurement, if desired, on 10Ω through 10,000Ω ranges. SOURCE terminals must be connected, either remotely or with shorting links at INPUT binding posts, for all resistance measurements.
Ohms	Ω	10, 100, 1000, 10K, AUTO		
Kilohms	KΩ	100, 1000, 10K, AUTO		
DVM Zero Adjustment	VDC, Filter	.1	Short INPUT terminals together. Use a low-thermal shorting link.	Adjust front panel DC ZERO control for readout of .000000 ±1.

2-17. EXTERNAL REFERENCE

2-18. General

2-19. The DC External Reference option enables the user to substitute an external dc voltage for the internal reference voltage. The principal use of the instrument when operated in this manner is for voltage ratio measurements. Another important use is to allow substitution of a system voltage for the 8375A reference voltage. By this means, variables in systems measurements may be reduced.

2-20. The DC External Reference Unit makes four-terminal voltage ratio measurements: ± dc to dc. Separate rear panel input connectors are provided for reference voltage inputs. The pin connection diagram for each connector is shown on a rear panel decal.

2-21. Operation

2-22. The following steps describe the basic operating procedure for ratio measurements using the External Reference options:

a. Select 8375A voltage range as desired according to the ratio range and corresponding readout, as shown in Table 2-4.

b. Connect reference voltage to rear input terminals.

c. Press EXT REF switch on the front panel.

d. Press VDC switch for dc-to-dc voltage ratios.

2-23. Installation, theory of operation, and maintenance instructions for the External Reference option is covered in Section 6 of the manual.

2-24. REMOTE CONTROL UNIT

2-25. General

2-26. The Remote Control Unit (RCU) enables the 8375A to be programmed or controlled remotely. RCU inputs interface directly with DTL/TTL logic. Control by discrete transistors or contact switches is also possible. Operating power for the RCU must be supplied from an external +5 volt source having a current capability of at least 150 milliamps. Power may be obtained from the Data Output Unit option if the instrument is so equipped.

Table 2-4. EXTERNAL REFERENCE RATIO RANGES

MODE	RATIO RANGE $\left(\frac{V_{INPUT}}{V_{REF}}\right)$	READOUT	REFERENCE INPUT
DC/DC X 10	0 to ±0.0119999 0 to ±0.119999 0 to ±1.19999 0 to ±11.9999 0 to ±100.00	0 to ±.119999 0 to ±1.19999 0 to ±11.9999 0 to ±119.999 0 to ±1000.00	+1V to +10.5V

2-27. The RCU provides the capability of controlling all functions and ranges, with logic interlocking provided so that incompatible functions or simultaneous ranges cannot be called. Acceptable combinations are shown in Table 2-5.

Table 2-5. REMOTE CONTROL UNIT LOGIC INTERLOCKING

FUNCTION CALLED	RANGE CALLED							FILTER	RATIO
	.1	1	10	100	1000	10K	NONE		
VDC	.1	1	10	100	1000	10K	AUTO	YES	YES
VAC	AUTO	1	10	100	1000	AUTO	AUTO	YES	YES
Ω	AUTO	AUTO	10	100	1000	10K	AUTO	YES	NO
KΩ	AUTO	AUTO	AUTO	100	1000	10K	AUTO	YES	NO

NOTE:
1. *If function and range are not called, DVM goes to VDC mode and autoranges (providing REMOTE button is pressed).*
2. *When ranges are selected manually, DVM will autofunction between Ω and KΩ if the selected range does not agree with the called function.*

2-28. RCU Command Triggering

2-29. The RCU has two operating modes which control entry of external commands into the unit: continuous command mode and triggered command mode.

2-30. In continuous command mode, the RCU requires no external triggering. The instrument always reflects present state of command inputs in continuous mode. To achieve this mode of operation, hold pin 35 (Auto Command Entry Defeat) and pin 33 (External Command Entry) at logical 1 (+5v) or open.

2-31. In triggered command mode, the RCU will only respond to programming inputs after application of an external trigger and will memorize input commands within 16 microseconds of trigger application. Following the storage operation, programming inputs may be changed or removed without affecting stored information. To achieve this mode of operation, hold pin 35 (Auto Command Entry Defeat) low by application of logical 0 or contact closure and apply the external trigger to pin 33 (External Command Entry). RCU connector location is shown in Figure 2-1. Pin assignments are given in Table 2-6. Trigger requirements (External Command Entry) are given in Figure 2-2.

2-32. Operation

2-33. To place DMM in remote operation, proceed as follows:

a. Press REMOTE FUNCTION switch to transfer control of DMM function and range to the remote control point.

b. If remote control of DMM sample rate is desired, turn SAMPLE RATE control to its extreme CCW position (EXT). In EXT position, the internal sample rate oscillator is disabled and the sample command is applied via the Data Output Unit. If the Data Output Unit is not installed and the control is turned to EXT, the DMM will readout and display from analog storage indefinitely. The readout will correspond to the value of the last measurement.

Table 2-6. REMOTE CONTROL UNIT PIN ASSIGNMENTS

FUNCTION	PIN NO.	FUNCTION	PIN NO.
Common	*2	$\overline{\text{VAC}}$	17
Common	*4	$\overline{\text{K}\Omega}$	19
Common	*6	$\overline{\Omega}$	23
$\overline{\text{1 Range}}$	7	$\overline{\text{1 Range}}$	25
Common	*8	$\overline{\text{100 Range}}$	27
+5V Input	**9	$\overline{\text{External Reference}}$	29
$\overline{\text{1000 Range}}$	11	$\overline{\text{Filter}}$	31
$\overline{\text{10K Range}}$	13	External Command Entry	***33
$\overline{\text{10 Range}}$	15	Auto Command Defeat	***35

Spare Pins: 1, 3, 5, 10, 12, 14, 16, 18, 20, 22, 24 26, 28, 30, 32, 34, 36

LOGIC LEVELS

LOGIC 1 = +5V OR OPEN (INPUT DEVICE MUST BE ABLE TO SOURCE 40μAMP AT 2.6V)

LOGIC 0 = 0V OR CONTACT CLOSURE (INPUT DEVICE MUST BE ABLE TO SINK AT 1.6 MA AT 0V)

TRUTH TABLE

1 - FUNCTION NOT CALLED
0 = FUNCTION CALLED

NOTES:

* *Isolated from Input "LO" and chassis*

** *+5V Input: Maximum current requirement = 150 milliamperes. (Available from DOU)*

*** *Used only in Control Command Storage mode of operation. No connections are required when RCU is controlled with continuously applied commands.*

c. Command a function or range via a contact closure or a zero-volt logic level between the appropriate pin and common. For example, to program 10k ohms, filtered operation, command pins 13, 23 and 31 via contact closure or zero volts to pin 2, 4, or 6 (commons).

2-34. Installation, theory of operation, and maintenance instructions for the Remote Control Unit are covered in Section 6 of the manual.

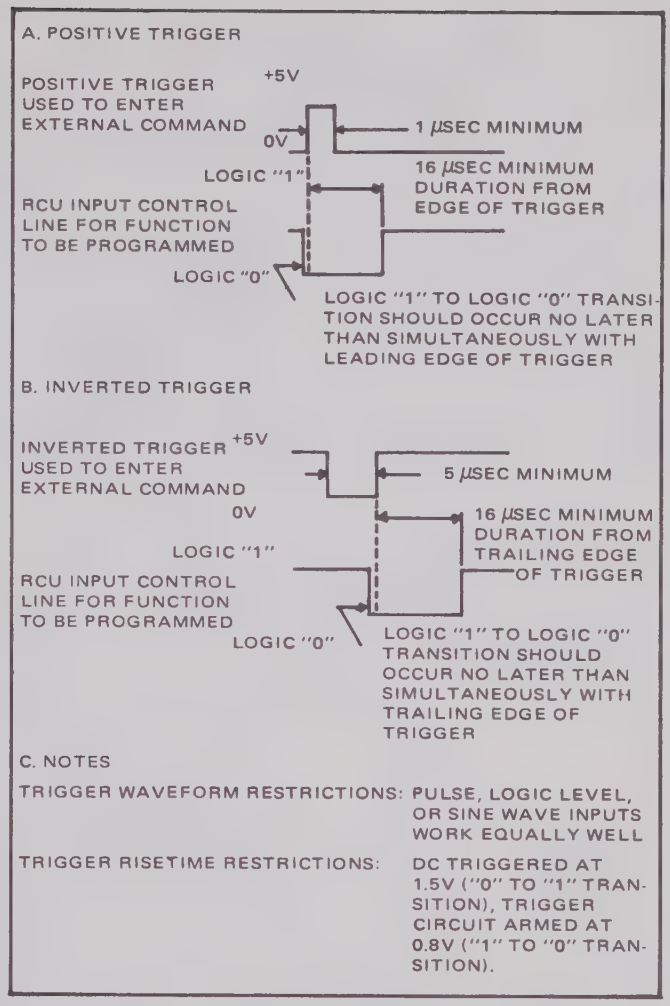

A. POSITIVE TRIGGER
POSITIVE TRIGGER USED TO ENTER EXTERNAL COMMAND
+5V
0V
1 μSEC MINIMUM
LOGIC "1"
16 μSEC MINIMUM DURATION FROM EDGE OF TRIGGER
RCU INPUT CONTROL LINE FOR FUNCTION TO BE PROGRAMMED
LOGIC "0"
LOGIC "1" TO LOGIC "0" TRANSITION SHOULD OCCUR NO LATER THAN SIMULTANEOUSLY WITH LEADING EDGE OF TRIGGER
B. INVERTED TRIGGER
INVERTED TRIGGER USED TO ENTER EXTERNAL COMMAND
+5V
0V
5 μSEC MINIMUM
16 μSEC MINIMUM DURATION FROM TRAILING EDGE OF TRIGGER
LOGIC "1"
RCU INPUT CONTROL LINE FOR FUNCTION TO BE PROGRAMMED
LOGIC "0"
LOGIC "1" TO LOGIC "0" TRANSITION SHOULD OCCUR NO LATER THAN SIMULTANEOUSLY WITH TRAILING EDGE OF TRIGGER
C. NOTES
TRIGGER WAVEFORM RESTRICTIONS: PULSE, LOGIC LEVEL, OR SINE WAVE INPUTS WORK EQUALLY WELL
TRIGGER RISETIME RESTRICTIONS: DC TRIGGERED AT 1.5V ("0" TO "1" TRANSITION), TRIGGER CIRCUIT ARMED AT 0.8V ("1" TO "0" TRANSITION).

Figure 2-2. REMOTE CONTROL UNIT TRIGGER REQUIREMENTS (EXTERNAL COMMAND ENTRY)

2-35. DATA OUTPUT UNIT

2-36. General

2-37. DOU access is by means of two card-edge connectors located at the rear of the instrument (Figure 2-1). Data may be acquired fully in parallel BCD format or serially by character in multiples of four-bits. The Programmed One-Shot (POS) line enables automatic time delays that allow for full settling of analog input circuitry prior to data transfer.

2-38. The DOU is self-powered and provides +5V (150 milliamperes maximum) output for operation of the Remote Control Unit (Option –02) or other logic circuitry. The truth tables, logic levels and functional pin connections for the DOU are given in Table 2-7.

Table 2-7. DATA OUTPUT UNIT FUNCTIONAL PIN CONNECTIONS

DATA	CONNECTOR PIN NO. DOU NO. 1	CONNECTOR PIN NO. DOU NO. 2	REMARKS
Range (coded)			RANGE / LINE b c d: 10000 0 0 0; 1000 0 0 1; 100 0 1 0; 10 0 1 1; 1 1 0 0; .1 1 0 1
b	33		
c	31		
d	32		
GR (gate)	36		
Overrange			
1	34		
GOR (gate)	35		
1st Decade (MSD)			Apply logic 0 to gates to inhibit decade data outputs.
8	27		
4	29		
2	28		
1	30		
G1 (gate)	25		
2nd Decade			
8	21		
4	23		
2	22		
1	24		
G2 (gate)	19		
3rd Decade			
8	15		
4	17		
2	16		
1	18		
G3 (gate)	13		
4th Decade			
8	9		
4	11		
2	10		
1	12		
G4 (gate)	5		
5th Decade			
8	3		
4	6		
2	2		
1	4		
G5 (gate)	1		
	Note: Logic 1 = +5V Logic 0 = 0 to 0.5V		

DATA	CONNECTOR PIN NO. DOU NO. 1	CONNECTOR PIN NO. DOU NO. 2	REMARKS
Control Inputs			
Ext. Trig.		3	
Ext. Trig. Inhibit		1	
Programmed One-Shot		2	
Primary Function Flags			Apply logic 0 to gates to inhibit function data outputs. Logic 1: Function active Negative polarity Logic 0: Function inactive Positive polarity
VDC		6	
VAC		4	
Ω		12	
KΩ		10	
GPF (gate)		26	
Secondary Function Flags			
Polarity		18	
Filter		20	
Ext. Ref.		16	
Remote		14	
GSF (gate)		22	
Flags:			Logic 1: / Logic 0:
Busy		8	Busy / Not Busy
Sample Sync		31	No Sam. Sync / Sam. Sync
Overload		13	Overload / No overload
Trigger		15	Triggered / Not Triggered
GOL (gate)		17	
Power Output			Maximum output: 150 milliamperes at +5 vdc.
+5 vdc	20	36,34	
Common		33,35	
Code Conversion Terminals			See paragraph 2-44 for code conversion information.
Z_{out}		9	
Z_1		30	
Z_{in}		25	
Y_{out}		5	
Y_1		32	
Y_{in}		21	
X_{out}		7	
X_1		29	
X_{in}		23	
W_{out}		11	
W_1		24	
W_{in}		19	

2-39. Control Signals

2-40. DOU control inputs consist of External Trigger, External Trigger Inhibit, and Programmed One-Shot. The External Trigger may be a positive or negative-going signal, as shown in Figure 2-3. The External Trigger Inhibit input must be a logical 0 to inhibit and a logical 1 to enable. The Programmed One-Shot input must be a logical 1 for fast operation (timeouts defeated) and a logical 0 for normal operation (programmed timeouts).

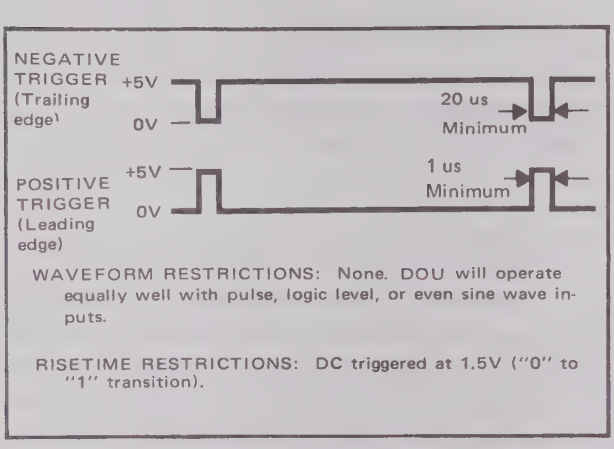

NEGATIVE TRIGGER (Trailing edge)
+5V
0V
20 us Minimum
POSITIVE TRIGGER (Leading edge)
+5V
0V
1 us Minimum
WAVEFORM RESTRICTIONS: None. DOU will operate equally well with pulse, logic level, or even sine wave inputs.
RISETIME RESTRICTIONS: DC triggered at 1.5V ("0" to "1" transition).

Figure 2-3. DATA OUTPUT UNIT TRIGGER REQUIREMENTS

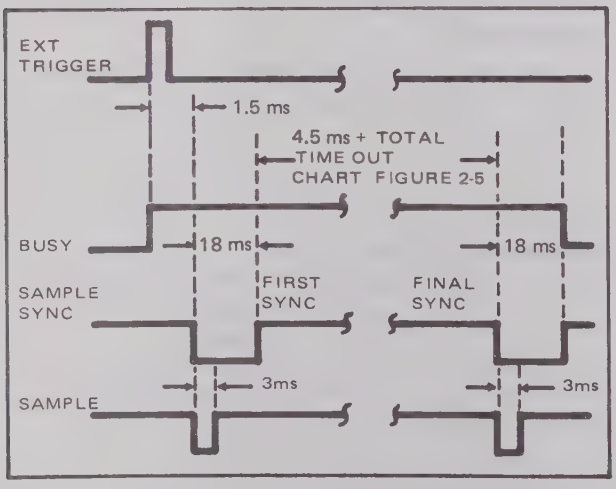


Figure 2-4. SAMPLE SYNC. SIGNAL TIMING (AUTOMATIC ADAPTIVE TIMEOUTS ENABLED).

2-41. The Sample Sync signal corresponds in timing to the DMM sample periods occurring in each measurement period, as shown in Figure 2-4. During the time the DMM is busy processing a request for data, the time of occurrence of the second or final sample period is subject to a number of delays, depending on DMM operating mode, autoranging delays, etc. The purpose of the Sample Sync signal is to inform the DMM input signal acquisition device (scanner) when the final sample is taken by the DMM. This information is useful when the DMM is used in a scanning system, where it is desirable that inputs be changed at the earliest possible time without altering the previous sample.

2-42. Programmed One-Shot

2-43. The response of the 8375A Data Output Unit to a data request consists of a function-dependent series of delays. When enabled, the Programmed One-Shot circuit in the DOU automatically sequences the delay series to provide data within specified accuracy in the minimum possible time. If settling time is not a problem in specific applications, convenience is enhanced by provision for defeat of the POS, allowing sample rates as high as 30 per second. Application of +5v logic level or open circuit to pin 2 defeats the POS (Fast Sample); application of logic zero or contact closure to pin 2 enables the POS (Normal Sample). Figure 2-5 illustrates the timing of the events that occur

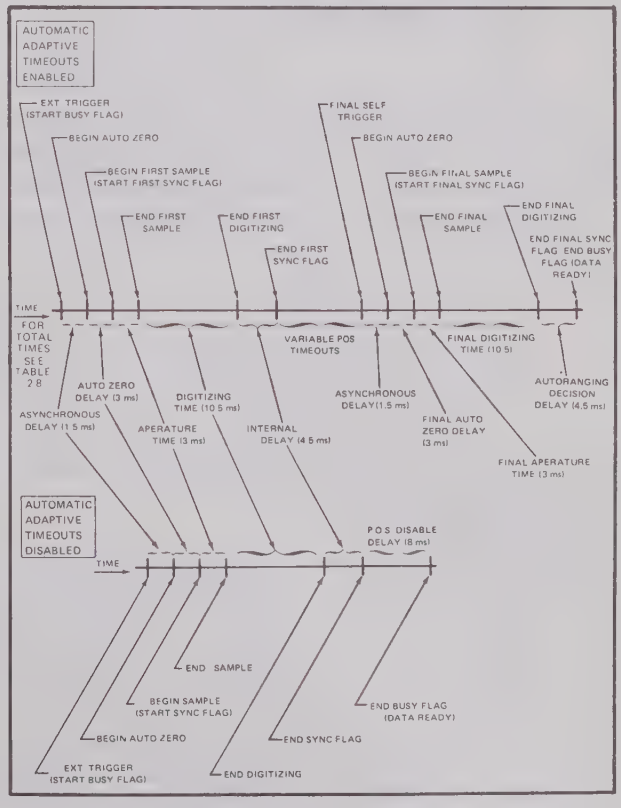

AUTOMATIC ADAPTIVE TIMEOUTS ENABLED
EXT TRIGGER (START BUSY FLAG)
BEGIN AUTO ZERO
BEGIN FIRST SAMPLE (START FIRST SYNC FLAG)
END FIRST SAMPLE
END FIRST DIGITIZING
END FIRST SYNC FLAG
FINAL SELF TRIGGER
BEGIN AUTO ZERO
BEGIN FINAL SAMPLE (START FINAL SYNC FLAG)
END FINAL SAMPLE
END FINAL DIGITIZING
END FINAL SYNC FLAG END BUSY FLAG (DATA READY)
TIME
FOR TOTAL TIMES SEE TABLE 2-8
AUTO ZERO DELAY (3 ms)
ASYNCHRONOUS DELAY (1.5 ms)
APERATURE TIME (3 ms)
DIGITIZING TIME (10.5 ms)
INTERNAL DELAY (4.5 ms)
VARIABLE POS TIMEOUTS
ASYNCHRONOUS DELAY (1.5 ms)
FINAL AUTO ZERO DELAY (3 ms)
FINAL DIGITIZING TIME (10.5)
AUTORANGING DECISION DELAY (4.5 ms)
FINAL APERATURE TIME (3 ms)
AUTOMATIC ADAPTIVE TIMEOUTS DISABLED
TIME
POS DISABLE DELAY (8 ms)
END SAMPLE
BEGIN SAMPLE (START SYNC FLAG)
BEGIN AUTO ZERO
EXT TRIGGER (START BUSY FLAG)
END SYNC FLAG
END DIGITIZING
END BUSY FLAG (DATA READY)

Figure 2-5. 8400A MEASUREMENT CYCLE TIMING DIAGRAM.

during the busy flag. The total busy flag time when the automatic adaptive timeouts are enabled, is given in Table 2-8.

Table 2-8. TOTAL BUSY FLAG TIME OUT
(Automatic Adaptive Timeouts Enabled)

FUNCTION RANGE	TOTAL TIME FILTER OUT	MS FILTER IN
VDC-10, 100, 1000	54 ±3	523 ±42
VDC-0.1, 1.0	123 ±10	523 ±42
VAC - all ranges	123 ±10	523 ±42
Ω – all ranges	123 ±10	523 ±42
kΩ – all ranges	73 ±6	523 ±42
Autorange – per range change	Add 50	Add 280

2-44. Figure 2-6 contains comprehensive timing diagrams for measuring both switched and continuously applied inputs when the D.O.U.'s automatic adaptive timeouts are not enabled.

2-45. OUTPUT FLAGS

2-46. Besides the Busy Flag (Data Not Ready), there is also a Sample Sync Flag. This flag goes to logic "1" when the DMM starts sampling the input signal (aperture window opening). By using the Sample Sync Flag (negative transisition - leading edge), plus an external 3 millisecond, one-shot delay, total data acquisition time can be decreased when using input scanners or a changing input signal which require long settling times. This will take advantage of the fact that the aperture window is only open for 3 milliseconds allowing the input signal to be changed and to be settled before the next sample aperture occurs. When the Automatic Timeouts are enabled, the final sample sync flag must be used instead of the initial or intermediate sync flags. See Figure 2-5 for timing of the sample sync flag.

2-47. The trigger flag indicates if the DMM is being triggered internally or externally. Other flags are the overload, Volts DC, Volts AC, Ohms, Kilohms, Polarity, Filter, External Reference and Remote Flags which are self-explanatory. Refer to Table 2-7 for pin connections and level information.

2-48. Code Conversion

2-49. The 8-4-2-1 BCD code (standard) used in the 8375A may be converted to some other code, using the convenient code conversion terminals provided at the output connector on DOU No. 2. To convert to another code remove the jumpers and connect the code conversion network, as shown in Figure 2-7. Usually only two integrated circuits are required in the network, versus about twelve for parallel conversion at the outputs, so a considerable saving may be realized.

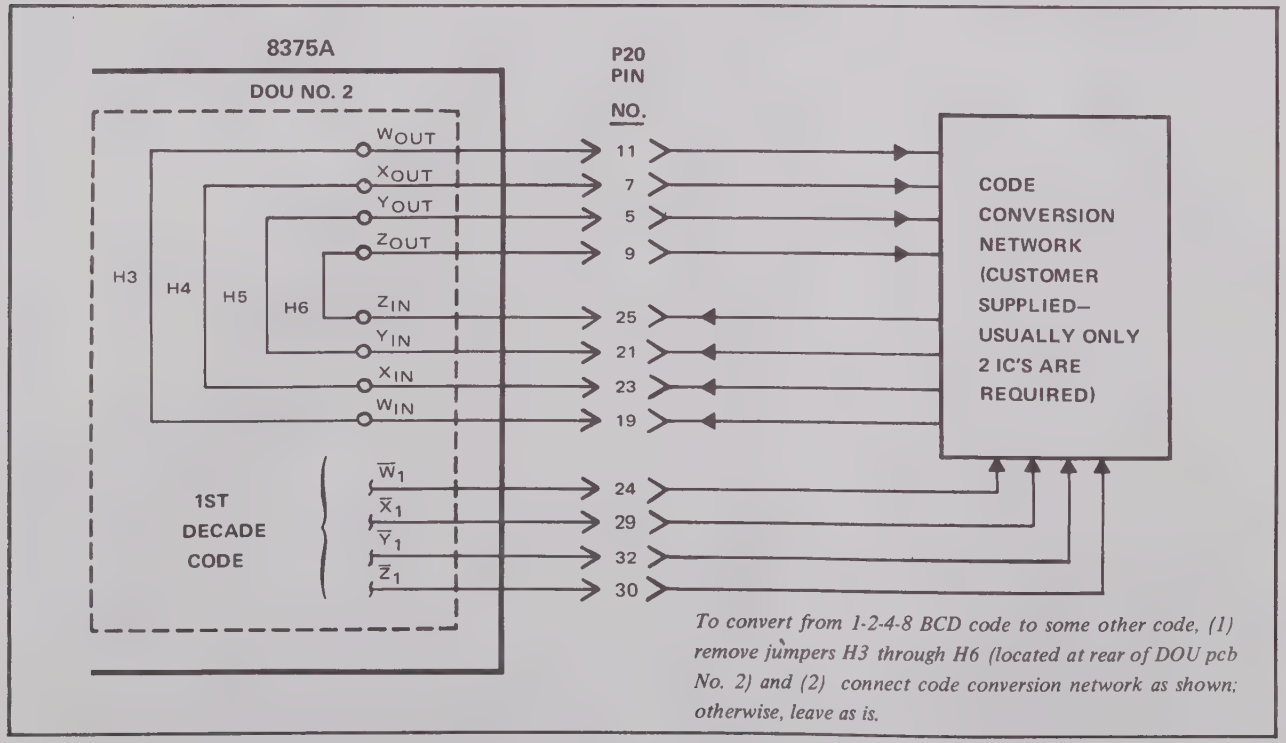
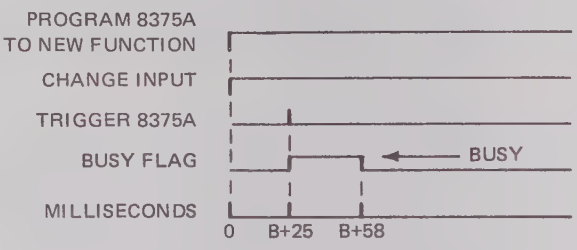


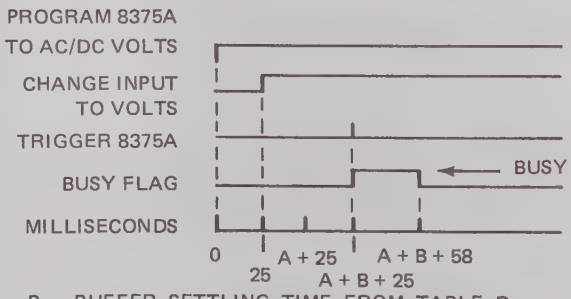
Figure 2-7. CODE CONVERSION

1. WITH PROGRAMMED FUNCTION AND/ OR RANGE CHANGE - AUTORANGING NOT ALLOWED.



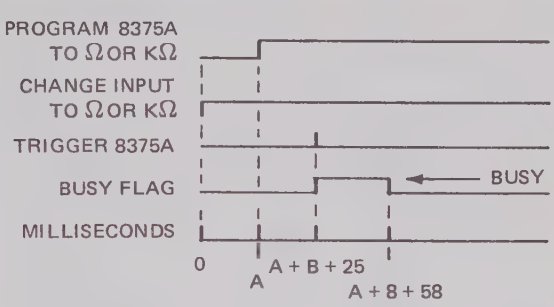
B = BUFFER SETTLING TIME FROM TABLE D
25 = TIME TO SWITCH 8375A INTERNAL RELAYS

a. SIMULTANEOUSLY CHANGE INPUT AND PROGRAM FROM A FORMER FUNCTION TO A NEW ONE WHEN FORMER INPUT DOES NOT CAUSE OVERLOAD CONDITION FOR NEW FUNCTION, OR NEW INPUT WOULD NOT CAUSE OVERLOAD CONDITION FOR OLD FUNCTION. (SEE SPECIFICATIONS ON DATA SHEET).



B = BUFFER SETTLING TIME FROM TABLE D
A = TIME TO SWITCH INPUT
25 = TIME TO SWITCH 8375A INTERNAL RELAYS

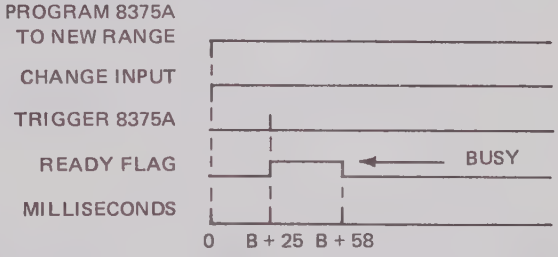
b. PROGRAM 8375A TO AC OR DC VOLTS FROM Ω OR KΩ, THEN APPLY A VOLTAGE INPUT GREATER THAN SPECIFIED Ω OR KΩ "OVERLOAD" INPUT. (SEE SPECIFI CATIONS ON DATA SHEET)



B = BUFFER SETTLING TIME FROM TABLE D
A = TIME TO SWITCH INPUT
25 = TIME TO SWITCH 8375A INTERNAL RELAYS

c. PROGRAM 8375A TO Ω OR KΩ FROM AC OR DC VOLTS WHEN INPUT VOLTAGE IS GREATER THAN SPECIFIED OVERLOAD FOR Ω OR KΩ INPUTS. (SEE SPECIFICATIONS ON DATA SHEET).

2. WITH PROGRAMMED RANGE CHANGE BUT NO FUNCTION CHANGE.



B = BUFFER SETTLING TIME FROM TABLE D
25 = TIME TO SWITCH 8375A INTERNAL RELAYS

TABLE D

BUFFER SETTLING TIME TABLE

FUNCTION	RANGE	BUFFER SETTLING TIME IN MILLISECONDS	
		FILTER "OUT"	FILTER "IN"
DCV	.1V	100	500
	1,10,100	33	500
	1000	33	500
ACV	ALL	33	500
Ω	10	100	500
	100,1000	33	500
	10,000	33	500
KΩ	100	33	500
	1000,1000	33	500

Figure 2-6. SINGLE READING TIMING REQUIREMENTS WHEN D.O.U.'S AUTOMATIC ADAPTIVE TIMEOUTS ARE NOT ENABLED.

2-50. Completely Parallel Data Acquisition

2-51. For completely parallel data acquisition, perform the following steps:

a. Determine the BCD code to be used and wire accordingly (see paragraph 2-48 for code conversion information).

NOTE!

8-4-2-1 BCD is supplied in standard 8375A.

b. Acquire full digits data by connection to the decade outputs. Leave inhibit lines associated with each decade open.

c. Acquire function, range, overrange and polarity data as desired. Leave associated inhibit lines open.

d. If data output is to be applied to a printer, the foregoing data could be grouped for presentation in several printer columns, with each column weighted as desired.

e. Acquire busy, overload, and trigger flags for use as desired.

2-52. Serial Character, Parallel Bit Acquisition

2-53. For serial character, parallel bit acquisition, perform the following steps:

a. Determine the BCD code to be used and wire accordingly (see paragraph 2-48 for code conversion information).

b. Connect function, range, polarity, and digit outputs, in parallel, as shown in Figure 2-8 or in groups of 8, 12, 16 bits, etc., as desired.

c. User supplied clock controls inhibit lines to determine the sequence of character acquisition. Data is transferred to the output lines when the associated inhibit lines are high. Truth tables and acquisition format are also shown in Figure 2-8.

2-54. Minimum Lines Acquisition

2-55. Minimum lines acquisition is a practical application of serial character, parallel bit acquisition, in which a user-supplied clock is placed near the 8375A to sequentially control the inhibit lines. Proceed as follows:

a. Place a customer fabricated 9-segment ring counter near the 8375A and interface as shown in Figure 2-9.

b. Trigger the 8375A. (The Sample Time line may be programmed via interface or it may be hard-wired.)

c. When data is ready, transition of the 8375A BUSY signal will start the ring counter. A synchronizing pulse, sent from the ring counter's advance line, will allow the acquisition device to recognize the character being acquired on the four output lines.

d. An OVERLOAD line is available to serve as an alarm or priority interrupt.

2-56. Installation, theory of operation, and maintenance instructions for the Data Output Unit are covered in Section 6 of the manual.

2-57. OPERATING NOTES

2-58. Overload Protection

2-59. The 8375A is protected against overload in each function and on all ranges. Table 2-9 lists the maximum voltages that may safely be applied to the DMM on all ranges.

2-60. Guarded Measurements

2-61. The 8375A employs a system of shields and guards that function (when properly connected) to minimize common mode-to-normal mode signal conversion and induced noise, thereby providing the user with a versatile systems DMM capable of fully-floating measurements without significant degradation of accuracy.

2-62. Non-floating measurements will likely be made with the 8375A. Under these conditions, it is satisfactory to strap the front panel guard (GD) terminal to the LO input terminal using the shorting link provided.

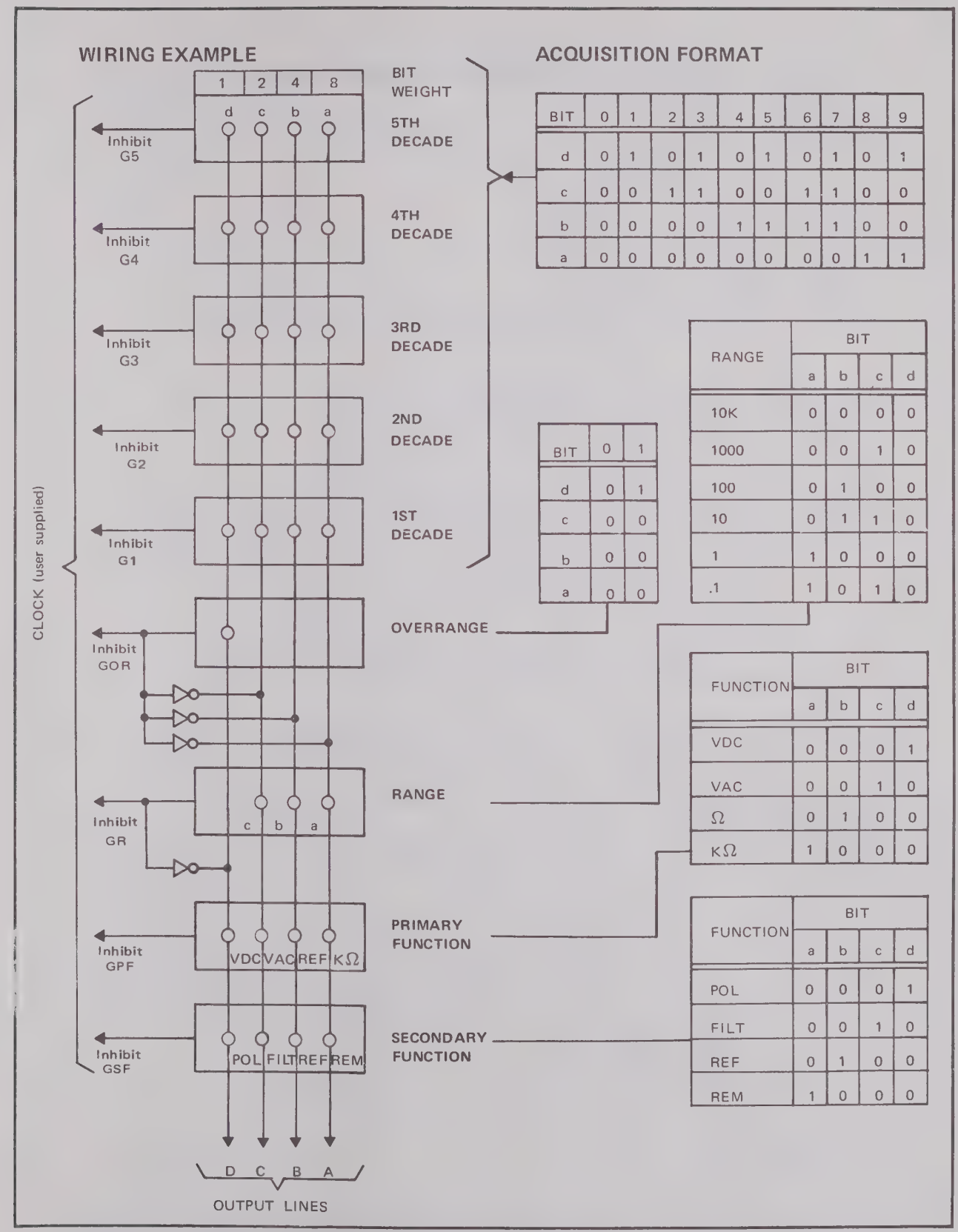

WIRING EXAMPLE
1 2 4 8
d c b a
Inhibit G5
Inhibit G4
Inhibit G3
Inhibit G2
Inhibit G1
Inhibit GOR
Inhibit GR
Inhibit GPF
Inhibit GSF
CLOCK (user supplied)
BIT WEIGHT
5TH DECADE
4TH DECADE
3RD DECADE
2ND DECADE
1ST DECADE
OVERRANGE
RANGE
PRIMARY FUNCTION
SECONDARY FUNCTION
c b a
VDC VAC REF KΩ
POL FILT REF REM
D C B A
OUTPUT LINES
ACQUISITION FORMAT
BIT 0 1 2 3 4 5 6 7 8 9
d 0 1 0 1 0 1 0 1 0 1
c 0 0 1 1 0 0 1 1 0 0
b 0 0 0 0 1 1 1 1 0 0
a 0 0 0 0 0 0 0 0 1 1
BIT 0 1
d 0 1
c 0 0
b 0 0
a 0 0
RANGE BIT a b c d
10K 0 0 0 0
1000 0 0 1 0
100 0 1 0 0
10 0 1 1 0
1 1 0 0 0
.1 1 0 1 0
FUNCTION BIT a b c d
VDC 0 0 0 1
VAC 0 0 1 0
Ω 0 1 0 0
KΩ 1 0 0 0
FUNCTION BIT a b c d
POL 0 0 0 1
FILT 0 0 1 0
REF 0 1 0 0
REM 1 0 0 0

Figure 2-8. WIRING EXAMPLE, ACQUISITION FORMAT, AND TRUTH TABLES FOR SERIAL CHARACTER, PARALLEL BIT ACQUISITION

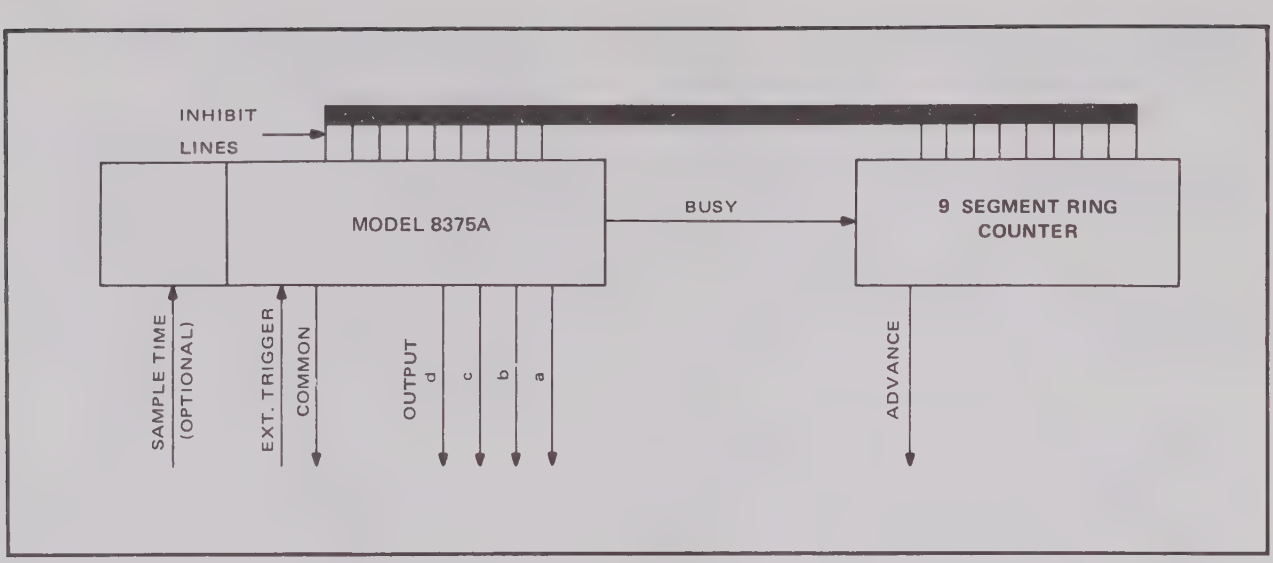


Figure 2-9. MINIMUM LINES ACQUISITION

Table 2-9. OVERLOAD PROTECTION CHARACTERISTICS

FUNCTION	MAXIMUM SAFE INPUT	FORM OF PROTECTION
VDC	±1100V dc or RMS (±1500V peak) continuously on any range.	Circuit Design
VAC	1100V RMS continuously on any range.	
RESISTANCE: 10Ω - 10,000KΩ ranges	20V RMS	FUSE: 15 ma fuse (with spare) located on Ohms Converter PCB
100 KΩ – 10,000 KΩ ranges	250V RMS continuously	Circuit Design
DC EXTERNAL REFERENCE	+10.5 (Note: The algebraic sum of the DVM input voltage and the common difference voltage should not exceed 13 volts dc or peak ac).	FUSE: 15 ma fuse located on DC External Reference Converter PCB protects mainframe if maximum common difference voltage is exceeded.

NOTE: Re-Calibration not necessary when fuses are replaced.

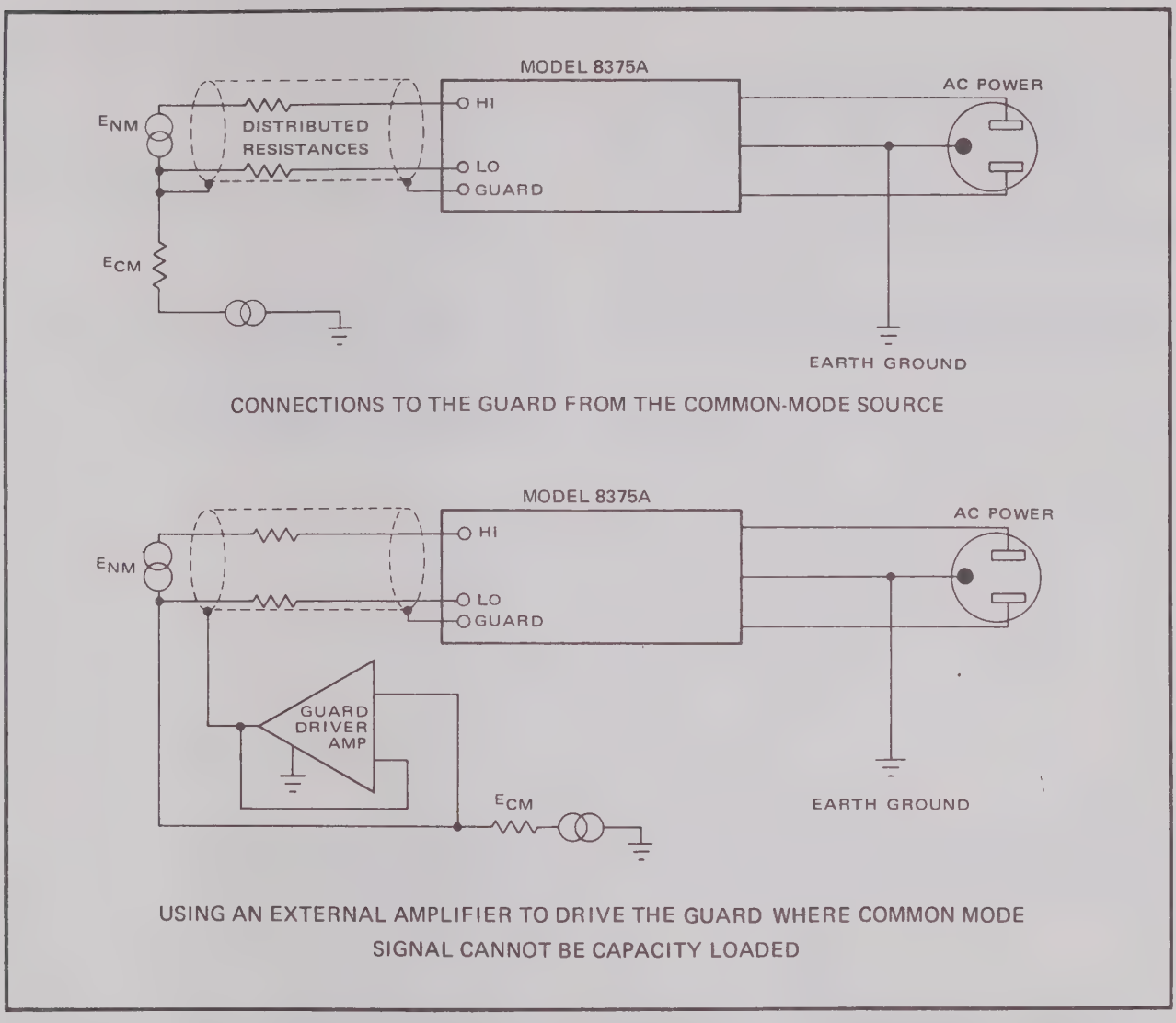


Figure 2-10. SUGGESTED GUARD CONNECTIONS FOR REDUCTION OF COMMON MODE-TO-NORMAL MODE SIGNAL CONVERSION

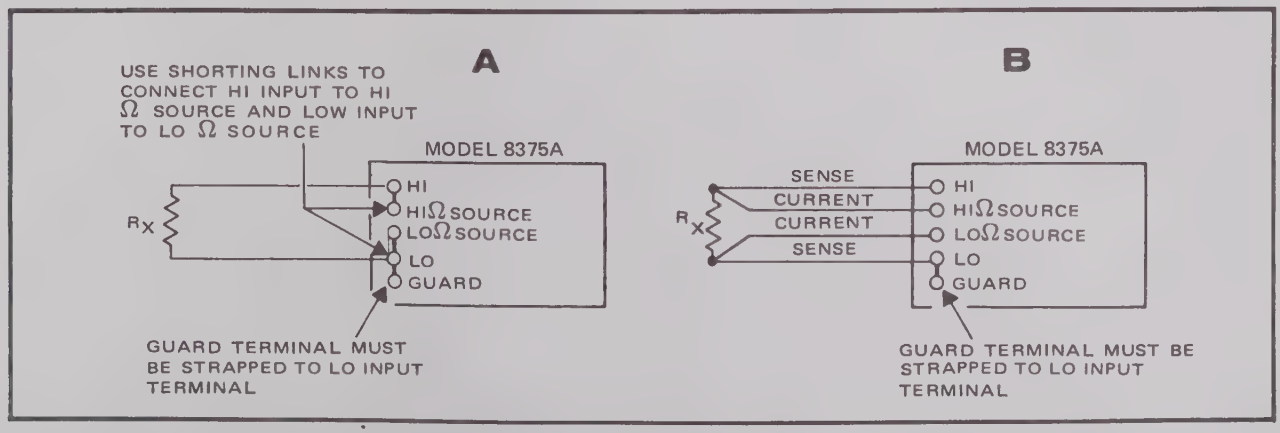


Figure 2-11. PROPER GUARD CONNECTIONS FOR (A) 2-TERMINAL Ω MEASUREMENTS WHEN SIGNAL LEADS ARE SHORT AND (B) 4-TERMINAL Ω MEASUREMENTS ON 10Ω THROUGH 10,000Ω RANGES

CAUTION!

If guarded measurement is not needed, the DMM guard terminal should be connected to the INPUT LO terminal at the front panel to preclude possible damage to the instrument.

2-63. In general, guarded voltage and resistance measurements will be necessary under the following conditions:

a. When long signal leads are used and signal source impedance is high.

b. When floating measurements are made and the common mode voltage is a high potential, high frequency, or both.

c. When the DMM is operating in the presence of high-level radiated noise, of which the most common example is stray fields at the power line frequency.

2-64. Figure 2-10 shows two methods for making guarded voltage measurements where reduction of common mode-to-normal signal conversion is desired. Figure 2-11 shows two methods for connection of the guard terminal when making ohms measurements.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section describes the theory of operation of the Model 8375A. The information is arranged under headings of "BLOCK DIAGRAM ANALYSIS" and "CIRCUIT DESCRIPTIONS." Simplified block diagrams and circuits are included with the text information. Schematic diagrams are located at the rear of the manual.

3-3. BLOCK DIAGRAM ANALYSIS

3-4. Buffer (A11)

3-5. The Buffer (A11) receives the dc input voltage and scales it up or down so that a full-scale input produces a full-scale 10V output to the active filter. (Refer to Figure 3-1.) When the 0.1 or 1V range is selected, the Buffer is configured as an amplifier having a gain of 100 or 10, respectively. In the 10, 100 or 1000V range, the A11 Buffer has a fixed unity gain and the input is scaled using a divider to provide the full-scale ±10V output.

3-6. Active Filter (A10)

3-7. The A10 Active Filter suppresses ac noise present in the Buffer output. It consists of a voltage follower and a four-pole filter. Filtering is in effect when the FILTER switch on the front panel is pressed. If this switch is not pressed, the four-pole filter is bypassed and the circuit functions as a voltage follower. The resulting filtered or unfiltered output is applied to the A9 A/D Converter.

3-8. Logic (A8)

3-9. The A8 Logic produces the master timing signals from which the measurement period in the instrument are established. It also produces the reference voltage upon which the accuracy and stability is based. The circuitry consists of a master clock, a six-state shift register, a current controlled oscillator (CCO), a four-bit binary counter, and a +7V reference supply. The master clock produces gating signals that synchronize all timing circuitry in the instrument. The shift register is driven by the clock signals and produces digit cycle control signals for the A9 A/D Converter. Any output from the A/D amplifier produces an output from the analog comparator which enables the CCO to send output pulses to the binary counter. The binary counter selects the appropriate steps in the A9 A/D Converter ladder such that the CCO output is ultimately disabled. The resulting state of the binary counter is also applied to the A14 Display and decoded to indicate the measured value. The ±7V reference supply output is applied to the ladder in the A9 A/D Converter.

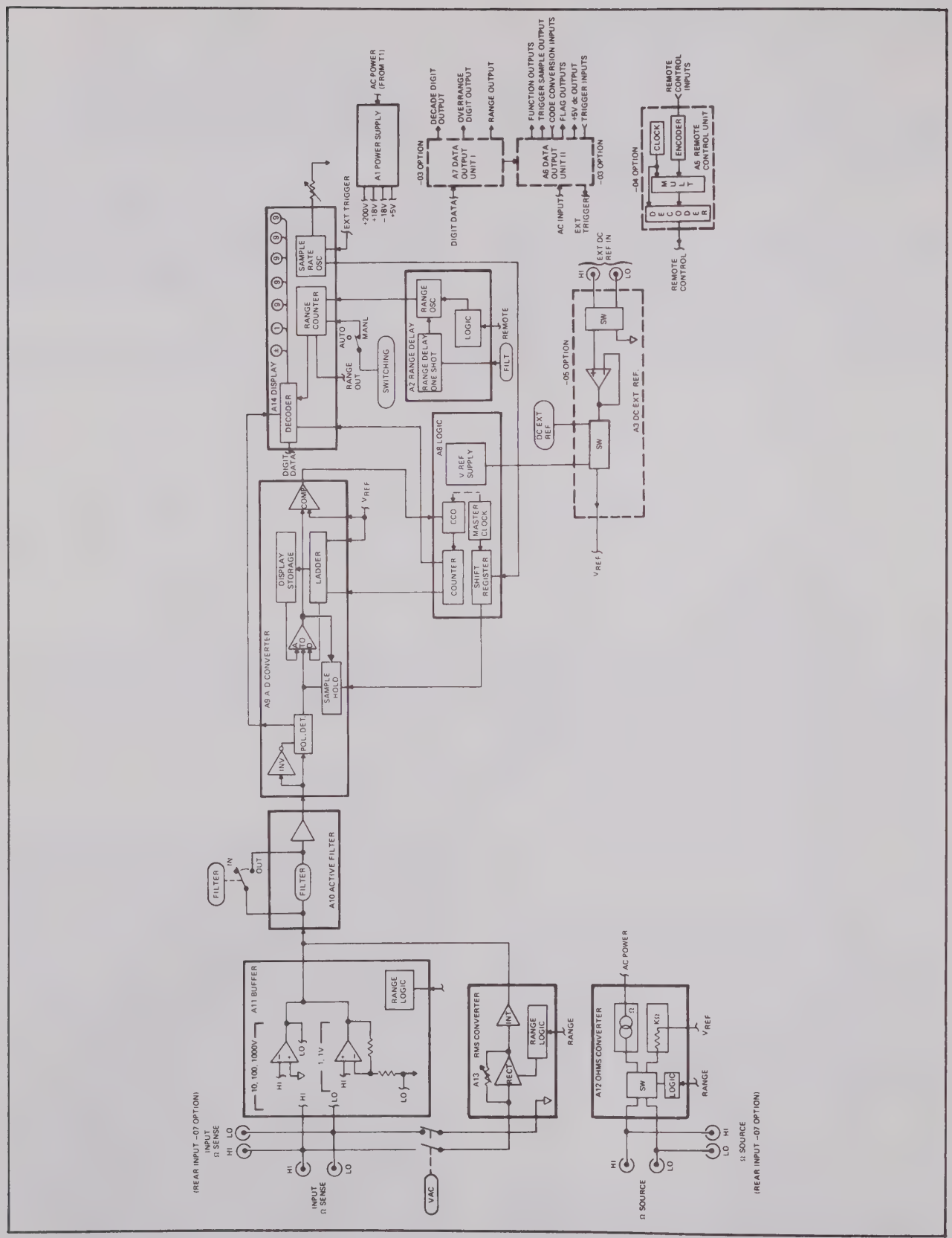


Figure 3-1. MODEL 8375A BLOCK DIAGRAM

3-10. A/D Converter (A9)

3-11. The A9 A/D Converter receives the output from the Active Filter, determines the polarity, and serially digitizes the input voltage. The digitizing process is controlled through commands from the A8 Logic assembly. The circuitry consists of an inverting amplifier, polarity detector, sample and hold, A/D amplifier, ladder switches, and an analog comparator amplifier. The inverting amplifier receives the positive or negative outputs of the A10 Active Filter and inverts the positive output so that the input to the A/D amplifier is always negative. Polarity of this signal is sensed by the polarity detector and applied to the A14 Display section. Any output voltage from the A/D amplifier, greater than Vref, produces an output from the analog comparator which then enables the CCO to send output pulses to the binary counter. The binary counter pulses gate the appropriate ladder switches in the A/D converter to produce a voltage across the primary ladder resistors. The resulting voltage is equal in value, but opposite in polarity, to that portion of the A/D amplifier input voltage that caused the amplifier output to be greater than Vref. As the degenerative affect of the primary ladder voltage causes the A/D amplifier output to fall below Vref, the analog amplifier will no longer enable the CCO to send output pulses to the ladder switches. At this point the digitizing process for the most significant digit of the unit input voltage is complete. The voltage level remaining at the output of the A/D amplifier, representing the 8375A input voltage minus the most significant digit is stored in the sample and hold circuit until the logic control gates it out to the input of the A/D amplifier. Each decade of the recirculated remainder is digitized in a simular fashion with one exception; the recirculated remainder voltage (now the A/D amplifier input voltage) and the primary ladder voltage are now the same polarity, because they are applied to opposite sides of the dual fet input transistor.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part.

3-12. Display (A14)

3-13. The A14 Display decodes and digitally displays the input voltage magnitude and polarity. It also provides a variable sample rate for control of the measurement cycle. The circuitry consists of a sample rate oscillator, range counter, decoder, and display indicators. The sample rate oscillator frequency is controlled by a SAMPLE RATE control on the front panel and determines the rate at which the input to the instrument is sampled. The range counter receives auto-range commands from the A2 Range Delay and manual range commands from the front panel switches. The range counter applies range information to the decoder and all input signal conditioning circuitry. Range, polarity, and digit information is processed in the decoder, which then produces the correct display condition in the indicators.

3-14. Range Delay (A2)

3-15. The A2 Range Delay processes switching inputs from the front panel and produces control commands for the decoder in the A14 Display. It also produces up/down autorange commands for the range counter. The circuit consists of logic, range delay one-shot, and a pulse generator. The logic circuitry produces control signals for the pulse generator and the decoder in the A14 Display. A clock signal for the range counter in the A14 Display is produced by the pulse generator. This clock signal is required for the autorange feature. The range delay one-shot produces a programmed time delay after any range change to allow for settling time of analog signal conditioners which process the input.

3-16. Power Supply (A1)

3-17. Operating voltages for the instrument are produced in the A1 Power Supply. The voltages produced are +200V, ±18V and +5V. Each voltage is derived from the ac input using a series regulator.

3-18. True RMS Converter (A13)

3-19. The True RMS Converter allows measurement of dc-coupled or ac voltages to 1100 volts rms at frequencies from dc to 300 kHz. The Converter provides a rms to dc transfer function for measurement of waveforms with high distortion and high crest factor characteristics. It also provides fast response time and excellent low-level accuracy. The circuitry consists of range logic, scaling amplifier, operational rectifier, squaring amplifier, square root amplifier, and DC integrator/filter amplifier. Range commands are processed in the range logic whose output then establishes a fixed scaling factor for the operational rectifier. The resulting full-scale +10V dc output from the DC integrator/filter amplifier is applied to the A10 Active Filter.

3-20. Ohms Converter (A12)

3-21. The A12 Ohms Converter allows resistance measurements from 100μΩ to 12MΩ. Resistance measurements in ohms ranges are true, four-terminal. Measurements in K ohm

ranges are conventional two-terminal. The circuitry consists of a constant current generator, a current source, switching circuitry, and logic. When the ohm function is selected, the constant current generator output is made available to the Ω SOURCE terminals. Since both the Ω SOURCE and SENSE terminals are connected to the unknown resistance, the A11 Buffer input voltage is directly proportional to the resistance value. The A11 Buffer output is then serially digitized and displayed as described previously to indicate the resistance value. In the K ohm ranges, a range dependent scaling resistor is placed between the master +7V reference supply and the HI SOURCE terminal. A voltage proportional to the unknown resistance (Rx) is available at the buffer output. Since the voltage drop in the lead resistance of the unknown also appears at the voltage measuring terminals, true four terminal measurement is not available. Simplified diagrams of the four terminal and conventional resistance configurations are shown in Figure 3-2.

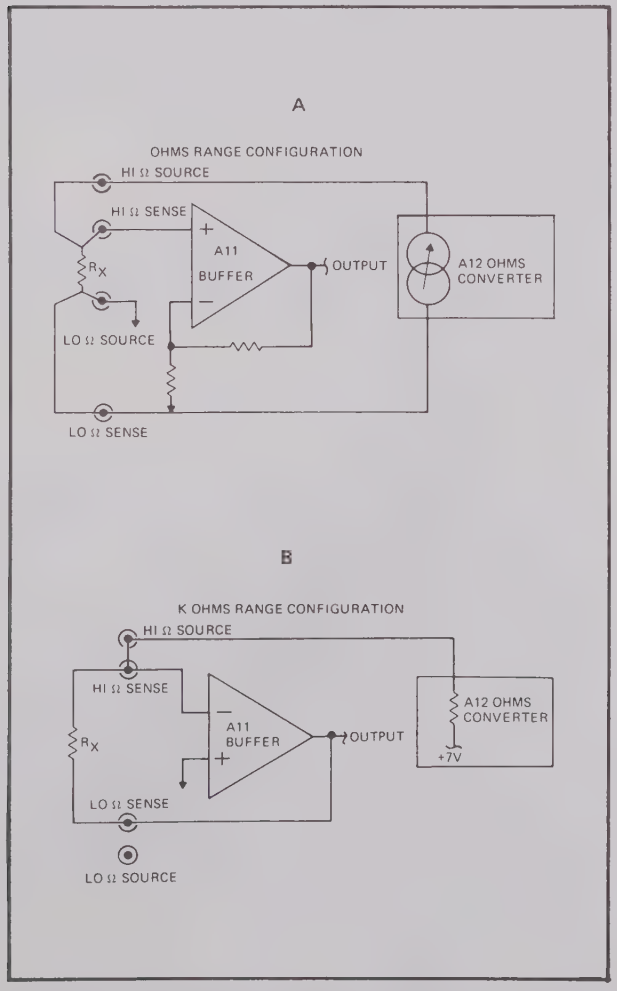


Figure 3-2. OHMS AND K OHMS RANGE CONFIGURATION

3-22. Data Output (A6/A7)

3-23. The A6 and A7 Data Output Units provide parallel, isolated, coded outputs of digit, polarity, range, and function. It also provides a +5V dc output for external equipment as well as input lines for external triggering and control of the measurement cycle. The circuitry is contained on two separate assemblies. Digit and range outputs are available from the Data Output Unit 1. Function indications, flag outputs and +5 dc outputs in addition to triggering and code conversion inputs are available in the Data Output Unit II.

3-24. Remote Control (A5)

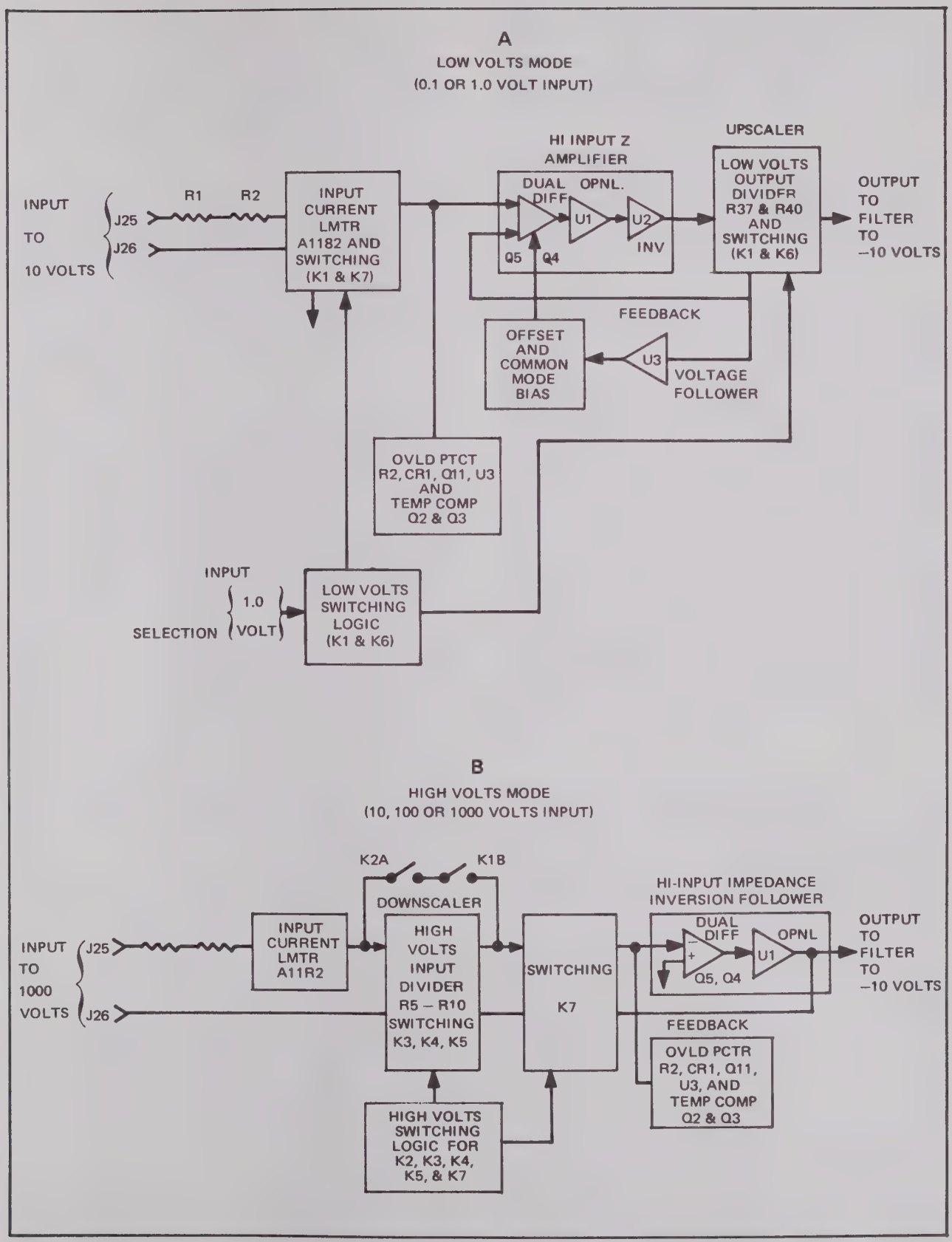
3-25. The A5 Remote Control Unit allows remote control of mode, instrument range, and functions. Input requirements are compatible with DTL or TTL logic levels. The circuitry consists of a clock generator, encoder, multiplexer, and decoder. The clock generator produces a clock signal which gates the multiplexer and decoder. Inputs are coded in the encoder and applied to the multiplexer. The multiplexer output is then serially transferred to the decoder at the clock rate. Serial to parallel conversion takes place in the decoder and the resulting commands used to control the range and function.

3-26. DC External Reference (A3)

3-27. The A3 DC External Reference allows dc/dc and ac/dc ratio measurements using an external dc reference voltage. Input reference voltage can be from +1 to +10.5V dc. The circuitry consists of a differential amplifier and a switching circuit. The external reference input is buffered by the differential amplifier. Application of internal or external reference voltage to the V_{REF} line is done through the switching circuit.

3-28. A11 Buffer

3-29. The A11 Buffer (Drawing No. 8375A-1005) provides a full-scale dc voltage of 10V, which is isolated from the input under measurement. It consists of four basic elements: input voltage divider, output voltage divider, amplifiers, and control logic. The circuitry has two operation configurations or modes determined by the voltage range selected: a low volts mode and a high volts mode. In the low volts mode (0.2 and 1.0 volt range) some amplification of the input occurs. In the high volts mode (10, 100 and 1000 volts range) input attenuation occurs, except in the 10 volts range when the input is processed without attenuation or amplification. Both modes are shown in block form in Figure 3-3. The A portion of the figure depicts the low volts mode, and the B portion of the figure depicts the high volts mode.


A
LOW VOLTS MODE
(0.1 OR 1.0 VOLT INPUT)
INPUT
TO
10 VOLTS
J25
J26
R1
R2
INPUT CURRENT LMTR A1182 AND SWITCHING (K1 & K7)
HI INPUT Z AMPLIFIER
DUAL DIFF
OPNL.
U1
U2
INV
Q5
Q4
UPSCALER
LOW VOLTS OUTPUT DIVIDER R37 & R40 AND SWITCHING (K1 & K6)
OUTPUT TO FILTER TO –10 VOLTS
FEEDBACK
OFFSET AND COMMON MODE BIAS
U3
VOLTAGE FOLLOWER
OVLD PTCT R2, CR1, Q11, U3 AND TEMP COMP Q2 & Q3
INPUT
SELECTION
1.0 VOLT
LOW VOLTS SWITCHING LOGIC (K1 & K6)
B
HIGH VOLTS MODE
(10, 100 OR 1000 VOLTS INPUT)
K2A
K1B
DOWNSCALER
HI-INPUT IMPEDANCE INVERSION FOLLOWER
INPUT
TO
1000
VOLTS
J25
J26
INPUT CURRENT LMTR A11R2
HIGH VOLTS INPUT DIVIDER R5 – R10 SWITCHING K3, K4, K5
SWITCHING K7
DUAL DIFF
OPNL
U1
Q5, Q4
OUTPUT TO FILTER TO –10 VOLTS
FEEDBACK
OVLD PCTR R2, CR1, Q11, U3, AND TEMP COMP Q2 & Q3
HIGH VOLTS SWITCHING LOGIC FOR K2, K3, K4, K5, & K7

3-30. The input to the A11 Buffer comes from input jacks J25 and J26, both jacks being shown on the block and system wiring diagrams. Buffer input current limiting resistors (R1 and R2 physically located on the front panel) are also shown on the system diagram.

3-31. Figure 3-3A shows the high input applied across current limiting resistor R2, through the contacts of K1 (A and B), to the high input impedance amplifier composed of three separate amplifiers: dual differential amplifier (Q5 and Q4), operational amplifier (U1), and inverter (U2).

3-32. The output of the amplifier is applied in parallel to the A10 Active Filter and to a gain determining network, R37 through R40, through contacts of relay K1 (C and D). The resistance ratios in the gain determining network are such that the feedback through the bootstrap amplifier (U3) will cause the amplifier output to be 100 times the input in the 0.1 volt range, and 10 times the input in the 1 volt range. Thus, the A11 Buffer can produce the required 10 volt output for a full scale input in either the 0.1 volt or 1 volt mode.

3-33. In the high volts mode of operation, shown in Figure 3-3B, the buffer input voltages are either used directly, in the 10 volt range, or divided by a resistor network in the 100 volt and 1000 volt range. In the 10 volt range the input voltage is directly applied to the high input impedance inversion follower via K2A, K2B, and K7A. In the 100 volt and 1000 volt ranges K3 will direct the input voltages across a voltage divider network. Relay K4 closes, when the 100 volt range is selected, and applies 1/10 of the input voltage to the inversion follower. The 1000 volt range closes K5 and applies 1/100 of the input voltage to the inversion follower.

3-34. Overload protection for the dual differential amplifier Q5 is afforded by the combination of components R2, CR1, Q11, and the current limiting resistors R1 and R2 shown on the system wiring diagram. Positive overvoltage protection is afforded by transistor Q11 which clamps the amplifier output to 1.7 volts. Negative overvoltage protection is afforded by diode CR1 which clamps the input to −1.7 volts.

3-35. A10 Active Filter

3-36. The A10 Active Filter (Drawing No. 8375A-1015) consists of a voltage follower preceded by four poles of low pass filtering. These four poles attenuate undesirable AC signals which may be present in the dc input signal. Filtering occurs after the FILT button on the front panel of the DMM is depressed. A block diagram of the active filter is shown in Figure 3-4. Also shown is the response curve of the active filter which plots attenuation in decibels against a log scale of frequency in Hertz.

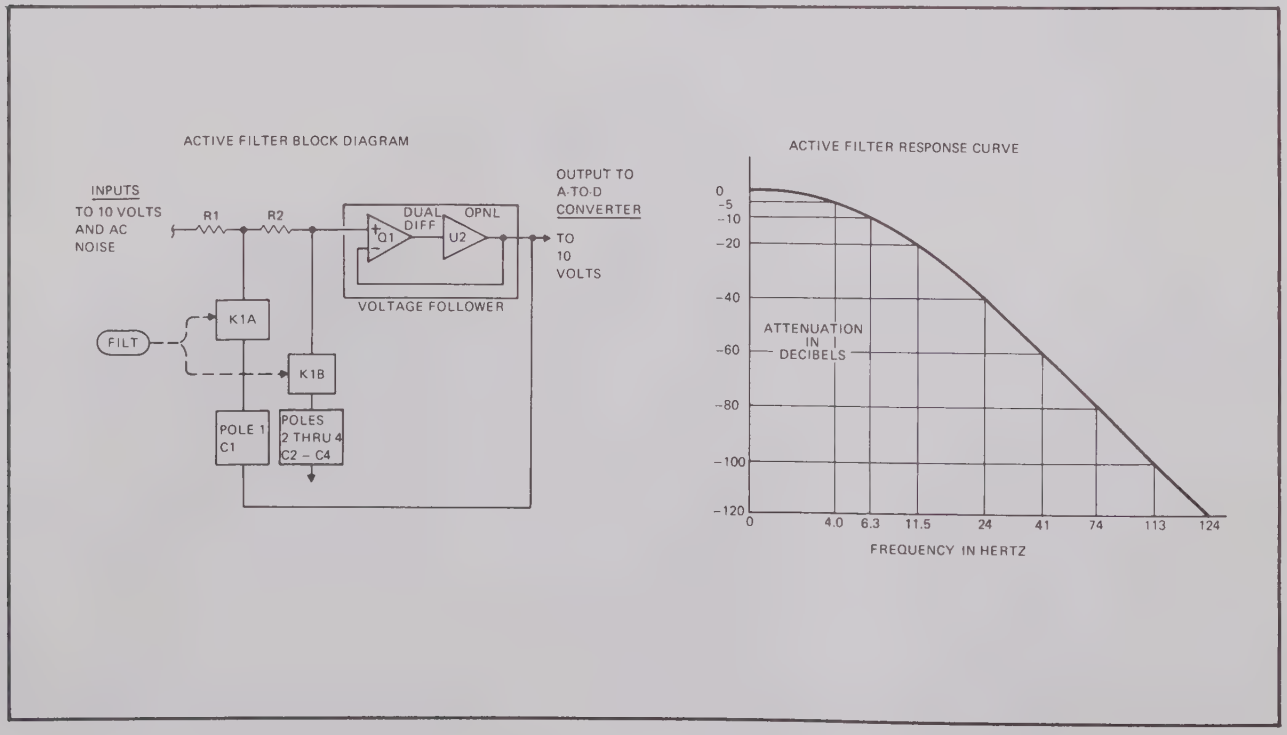


Figure 3-4. ACTIVE FILTER

3-37. A9 A-to-D Converter and A8 Logic

3-38. The A9 A-to-D Converter and A8 Logic circuits (respectively, Drawings No. 8375A-1003 and -1004) are discussed together in the following paragraphs, since any discussion of the analog-to-digital (A-to-D) conversion process must include elements of both circuits. The basic conversion and logic circuitry involved in the conversion process is shown in Figure 3-5. Also shown is an arbitrary input voltage that is the equivalent to the inverted voltage applied across the input jacks of the DMM. The basic purpose of the combined converter-logic circuitry is to convert the analog voltage input (given as +6.3524 dc volts in Figure 3-5) to binary coded bit groups, one bit group per decade.

3-39. The inverting amplifier consists of input switch Q3, dual FET input amplifier Q4, operational amplifier U1, and associated circuitry. Once every 18 milliseconds, during the C sub-period the inverting amplifier switch Q6 is switched on by the S5 Logic Signal, to zero the inverting amplifier. The automatic zero circuit consists of transistors Q5 and Q6 and capacitor C2. The drive circuit also supplies a turn-off signal to transistor Q3, thereby removing the input to the inverting amplifier during the C sub-period.

3-40. The polarity detector consists of flip-flop Q10, Q11 and associated circuitry. The flip-flop employs base triggering, which is applied through diode CR6 to the base of Q10. The gate signal, gate 4, is applied to the emitters of Q10 and Q11 and enables the detector during A sub-period. During the remainder of the measure period, the plus and minus gates (Q8 and Q7, respectively) are turned off and the polarity information is retained by the display circuitry.

3-41. The A/D amplifier consists of dual FET Q20, operational amplifier U2, and associated components. The A/D amplifier ZERO (0) circuit is comprised of transistors Q23 and Q24 and capacitor C7. Switch Q24 is turned on during the ZERO (0) sub-period of the measurement period by a ZERO signal from the Logic Circuit. This signal also controls switches Q19 and Q31, which are turned on during the ZERO sub-period, and switch Q30, which is turned off during the ZERO sub-period to disconnect the amplifier output from the ladder. Transistor Q29 and resistor R54 constitute a clamp, which prevent amplifier U2 from saturating while its output is above 7 volts.

3-42. The analog comparator, consisting of transistors Q35, Q32, Q33, Q34 and associated components, is a voltage comparator. Differential amplifier stage Q35 compares the A/D amplifier output voltage with the +7 volts reference, and Q33 and Q34 supply the outputs to the current controlled oscillator (CCO). Transistor Q32 operates as a second comparator, which responds quickly to high voltage levels, thereby allowing maximum time for resolution of the least significant digit.

3-43. The sample and hold circuit consists of transistors Q25 through Q28 and capacitors C9 and C10. The sequence of operation for the sample and hold circuit is shown in Figure 3-6.

3-44. The ladder switches of Q37 through Q44 are controlled by drivers Q19 through Q22 on the A8 logic board. The outputs of the ladder switches are applied to two ladders. Each ladder comprises a 4-bit, weighted-resistor, digital-to-analog converter. The primary ladder consists of resistors R44 through R50 and produces an output voltage that corresponds to the actual value of each digit of the input. The secondary ladder, which drives only the display storage circuit through buffer amplifier U3, consists of resistors R40 through R43 and produces an output that closely approximates the actual value of the digital input. A half-digit bias is produced by R38 and R39 in conjunction with the secondary ladder resistors and adds the voltage equivalent of a half-digit to the output of the secondary ladder. This ensures proper display storage read-out by compensating for the effects of voltage decay in the storage unit.

3-45. The display storage circuit consists of FET switches Q13 through Q17, capacitors C11 through C15, and FET switches Q12 and Q18. The buffered output of the secondary ladder is supplied to the appropriate storage capacitor through Q18, which is switched on during the second half (display time) of each sub-period. The first (most significant) digit is stored on C13, the second on C11, etc. When the cycle change circuitry switches to storage mode, Q12 is turned on and the analog voltages stored on the storage capacitors are serially applied to the input of the A/D amplifier. Thus, the same reading is continually digitized and displayed until a new sample is taken.

3-46. The 333 Hz clock signal is produced by transistor Q1 on the A8 Logic board. The clock frequency is determined by the RC time constant of resistor R1 and capacitor C1. The output of Q1 is applied to the clock input of flip-flop U1B. The F output of U1B is inverted in Q4 and becomes the $\overline{H}$ signal. The F, $\overline{F}$ and $\overline{H}$ signals are used by the logic to generate control signals.

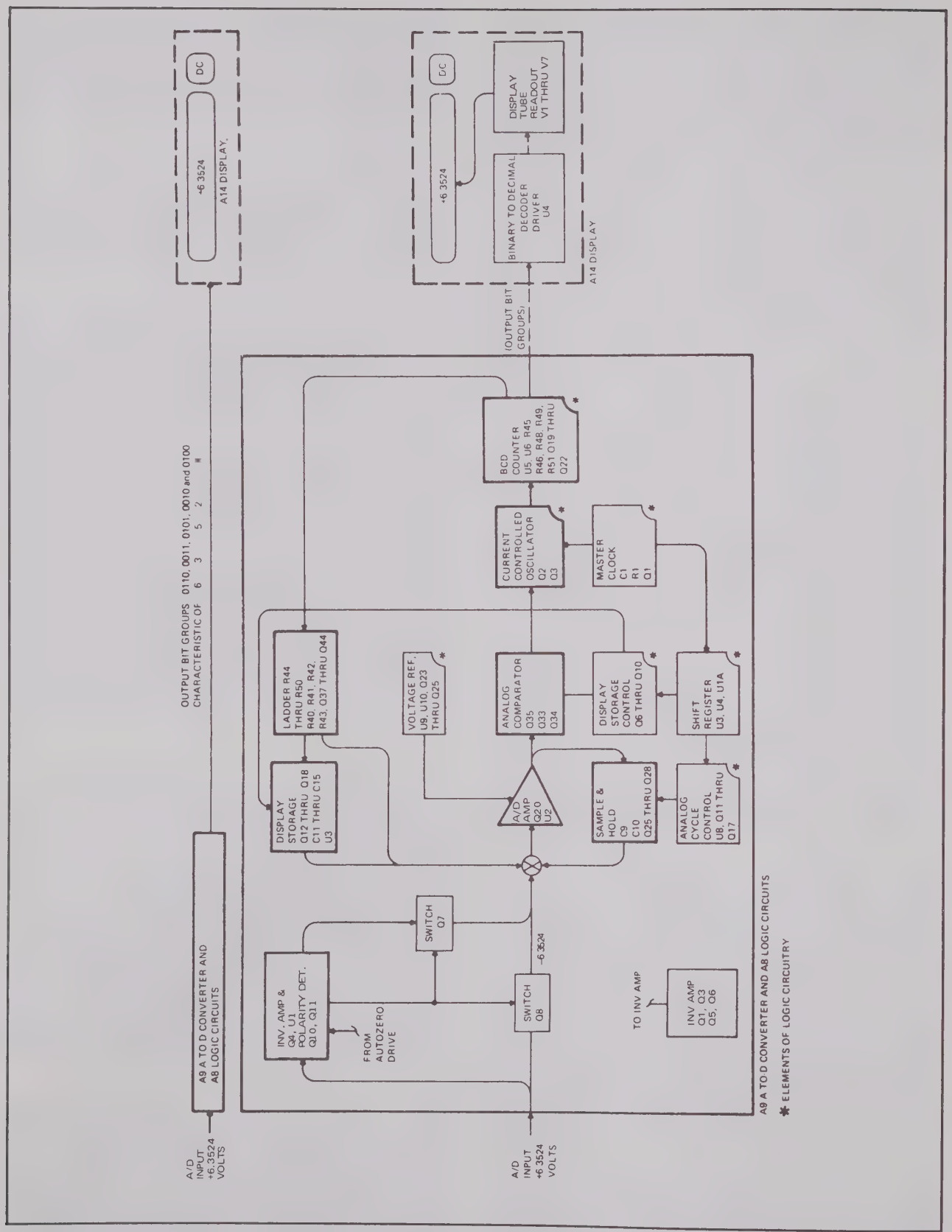

A14 DISPLAY
+6.3524
DC
DISPLAY TUBE READOUT V1 THRU V7
BINARY TO DECIMAL DECODER DRIVER U4
(OUTPUT BIT GROUPS)
OUTPUT BIT GROUPS 0110, 0011, 0101, 0010 and 0100
CHARACTERISTIC OF 6 3 5 2
BCD COUNTER U5, U6, R45, R46, R48, R49, R51 Q19 THRU Q22
CURRENT CONTROLLED OSCILLATOR Q2 Q3
MASTER CLOCK C1 R1 Q1
LADDER R44 THRU R50 R40, R41, R42, R43, Q37 THRU Q44
VOLTAGE REF. U9, U10, Q23 THRU Q25
ANALOG COMPARATOR Q35 Q33 Q34
DISPLAY STORAGE CONTROL Q6 THRU Q10
SHIFT REGISTER U3, U4, U1A
DISPLAY STORAGE Q12 THRU Q18 C11 THRU C15 U3
A/D AMP Q20 U2
SAMPLE & HOLD C9 C10 Q25 THRU Q28
ANALOG CYCLE CONTROL U8, Q11 THRU Q17
SWITCH Q7
INV. AMP & Q4, U1 POLARITY DET. Q10, Q11
FROM AUTOZERO DRIVE
SWITCH Q8
-6.3524
TO INV AMP
INV AMP Q1, Q3 Q5, Q6
A9 A TO D CONVERTER AND A8 LOGIC CIRCUITS
A9 A TO D CONVERTER AND A8 LOGIC CIRCUITS
A14 DISPLAY
+6.3524
DC
A/D INPUT +6.3524 VOLTS
A/D INPUT +6.3524 VOLTS
* ELEMENTS OF LOGIC CIRCUITRY

Figure 3-5. A-TO-D CONVERTER AND LOGIC BLOCK DIAGRAM

MEASURE PERIOD SUBPERIODS	SWITCHES ON	VOLTAGES STORED ON SAMPLE AND HOLD CAPACITORS	
		C9	C10
A	Q26, Q22	3.524	0
B	Q25, Q28	3.524	5.24
C	Q27, Q26	2.4	5.24
D	Q25, Q28	2.4	4.0
E	Q27	0	4.0
ZERO (Ø)	Q19, Q31, Q24	0	?

1 VOLTAGES SHOWN ARE ONLY PROPORTIONAL TO ACTUAL VOLTAGES.

Figure 3-6. SAMPLE AND HOLD SWITCHING

3-47. The six-state shift register consists of J-K flip-flops U3A, U3B, U4A, U4B and U1A. Error correction gate U2B controls the input to flip-flop U3B to ensure proper operation of the shift register. At the end of a typical digitizing cycle, flip-flop U1A reverts to the Logic zero condition upon receiving the $\overline{H}$ clock pulse. Since all the flip-flops are now in the Logic zero condition, the output of U2B goes low, thereby defining the start of the ZERO sub-period as shown in the timing diagram of Figure 3-9. The ZERO sub-period is terminated by the next $\overline{H}$ clock pulse, which sets flip-flop U3B high because its J input was high and its K input was low when the clock pulse was received. Subsequent clock pulses set the flip-flop outputs as shown in Figure 3-7.

SUBPERIOD	SHIFT REGISTER FLIP FLOP AND ZERO GATE OUTPUT STATES					
	U3B	U3A	U4A	U4B	U1A	U2B
ZERO	0	0	0	0	0	0
A	1	0	0	0	0	1
B	0	1	0	0	0	1
C	0	0	1	0	0	1
D	0	0	0	1	0	1
E	0	0	0	0	1	1

Figure 3-7. SHIFT REGISTER OUTPUTS

3-48. The sixteen-state binary counter consists of J-K flip-flop U5B, U5A, U6A and U6B. The counter is set to zero at the beginning of each sub-period in the measurement period by the $\overline{H}$ clock pulse. During each sub-period of the digitizing cycle, the output pulses from the CCO, which are applied to the clock input of flip-flop U5B, are counted. The truth table for the flip-flops in the binary counter is shown in Figure 3-8. The binary counter is disabled by gate U2A if the count of 11 is attained.

CCO PULSE COUNT	SIXTEEN-STATE BINARY COUNTER			
	U5B Z	U5A Y	U6A X	U6B W
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1

Figure 3-8. SIXTEEN-STATE BINARY COUNTER OUTPUT

3-49. The CCO consists of multivibrator Q2 and Q3. The CCO has no output until it is supplied current by the analog comparator and is enabled by the F output of the J-K flip-flop U1B. The CCO output is applied to the clock input of the 16-state binary counter. The 9's catcher gate U7A, disables the CCO at a count of nine, if the DMM is digitizing the second through fifth digits (sub-periods B through E).

3-50. The outputs of the six-state shift register, in conjunction with the H pulses, are applied to the display storage control circuit consisting of transistors Q6 through Q10 and related components. Outputs from this circuitry control the display storage circuit located on the A9 A-to-D Converter board.

3-51. The analog cycle control circuit produces the gating and control signals which are used to control the synchronization of events in the analog portion of the DVM, principally in the A-to-D Converter circuits. These signals, together with other control signals are shown in the DMM Timing and Synchrony Diagram, Figure 3-9. The analog cycle control circuit consists of NAND gates U8A through D driving transistors Q11 through Q17 and associated circuit elements.

3-52. The ladder switch driver circuitry (Q19 through Q22 on A8 Logic board) receives 8-4-2-1 coded binary data from the sixteen-state binary counter and translates this to 4-4-2-1 coded binary data, which matches the weighting of the resistors in the ladder. Thus, the ladder output is proportional to the count in the binary counter. Each count applied to the ladder switches will cause the output voltage from the primary ladder to decrease the voltage level applied to the A/D amplifier by one digits worth. When the count produces sufficient voltage to exactly offset

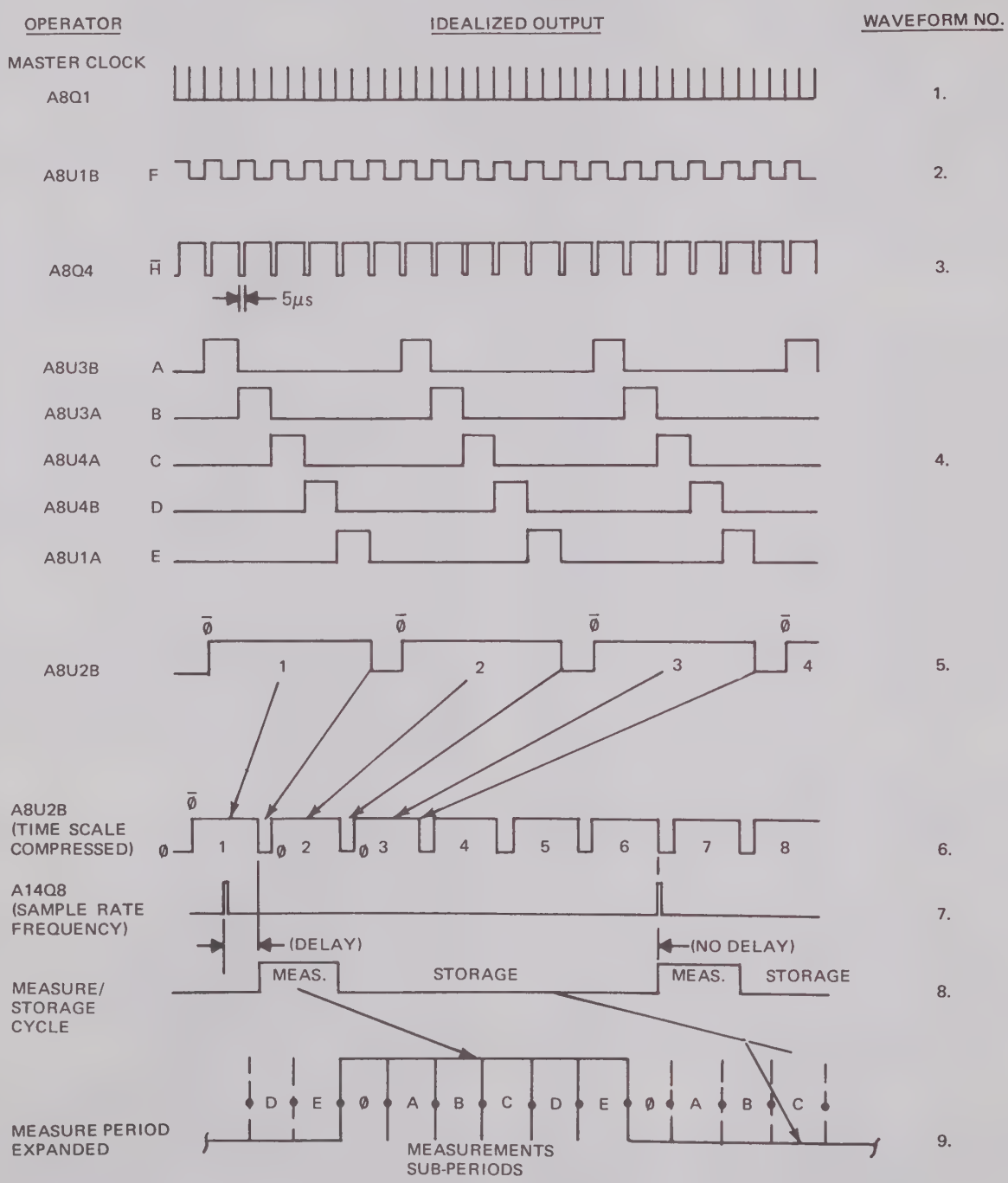


Figure 3-9. DMM TIMING AND SYNCHRONY DIAGRAM (SHEET 1)

the most significant digit of the A/D amplifier input voltage, the count for that particular sub-period will stop.

3-53. The +7 volts reference for the instrument is derived using reference amplifier U9 as a reference element. The reference voltage is produced using operational amplifier U10 and emitter follower Q25, which presents a low source impedance at the reference point. Transistor Q24 disables the +7 volts reference in the event the user wishes to employ an external reference and the required option is installed. Transistor Q23, coupled with the zener in the reference amplifier, produces a reference voltage for the +18 volts regulator in the A1 Power Supply.

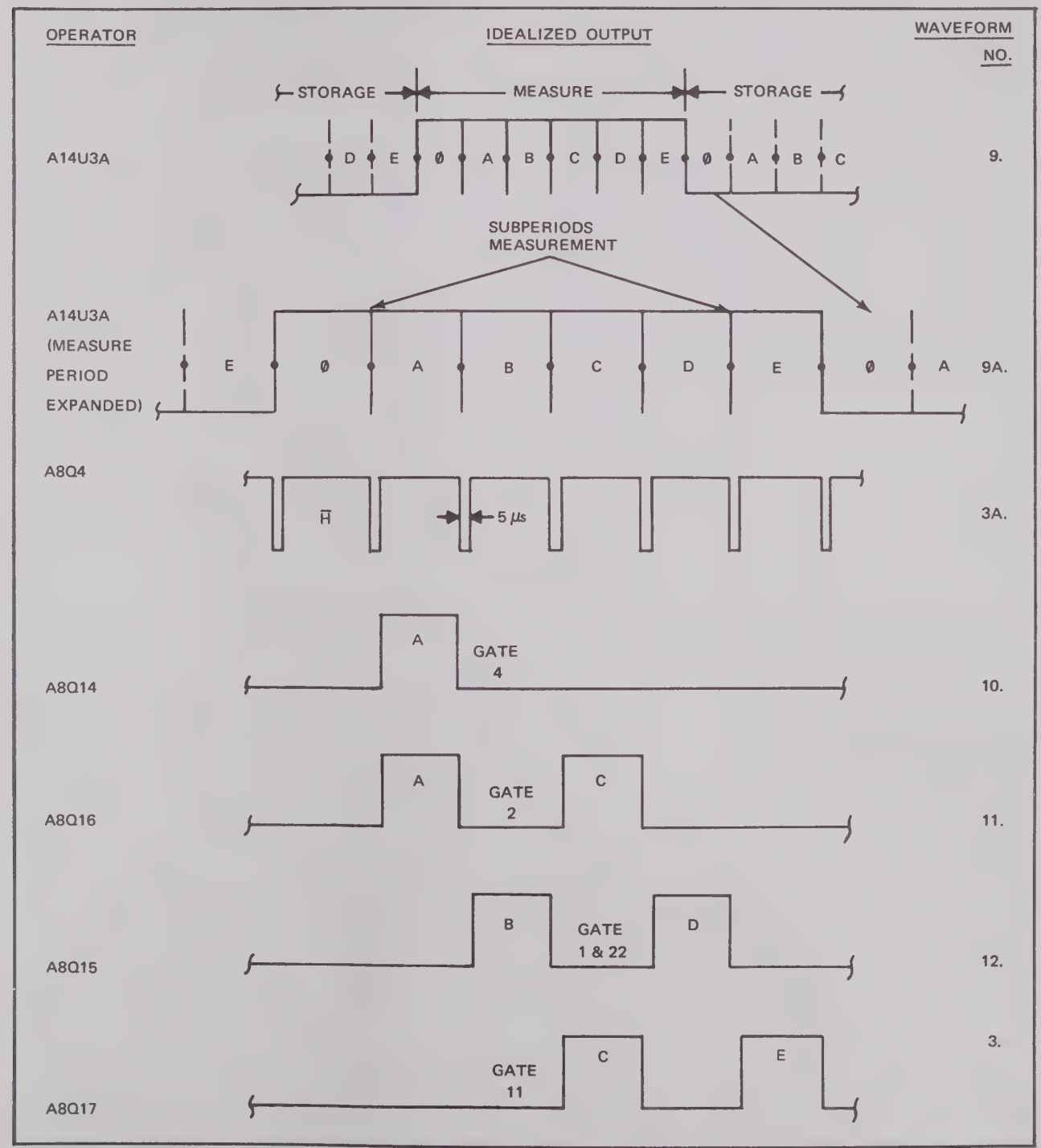


Figure 3-9. DMM TIMING AND SYNCHRONY DIAGRAM (SHEET 2)

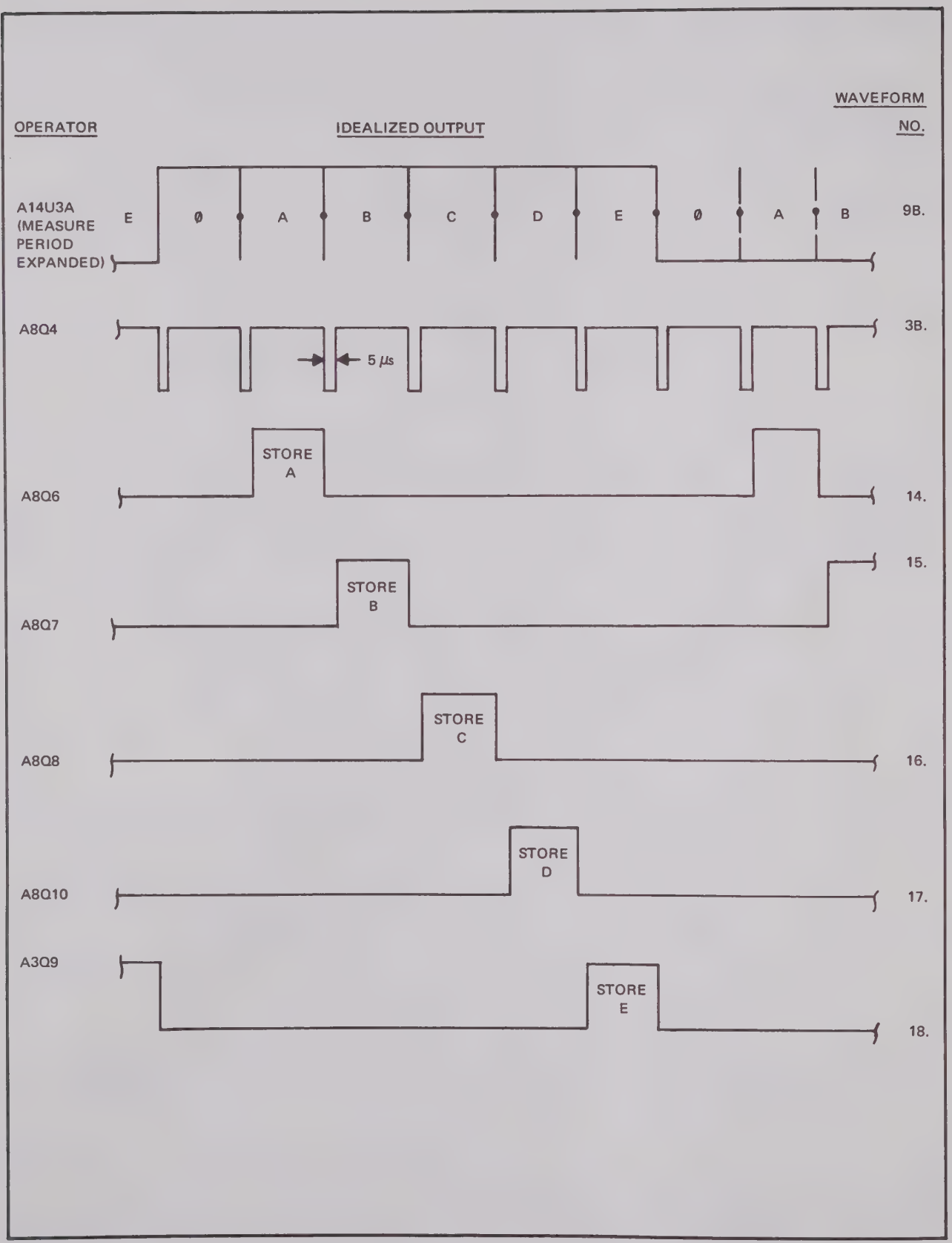


Figure 3-9. DMM TIMING AND SYNCHRONY DIAGRAM (SHEET 3)

3-54. A14 Display

3-55. The A14 Display circuits (Drawing No. 8375A-1002) control the function/status indicators and the decimal indicators associated with the readout tubes. The KΩ, AC, DC, Ω, OVER, FILT, and X REF indicators are controlled by the respective function control lines. They are illuminated when +5 volts dc is applied to the control line; however, the control lines are interlocked to the associated assembly so that the indicator remains extinguished unless the assembly is installed in the instrument. The OVER range indicator is operated by transistor Q5 in the OVER RANGE DRIVER circuit.

3-56. The polarity signs + and – of tube V1 are controlled by a flip-flop consisting of transistors Q19, Q20, FET switches Q32, Q33, current source transistors Q9, Q10, and associated components. Inputs to this circuit are VDC, C, POL INFO A and B, and a. POL INFO A and B come from the polarity detector in the A-to-D Converter and determine which of the two polarity characters are illuminated. The (a) output, of the range counter reverses the effects of POL INFO A and B as a function of range to account for the fact that the polarity detector receives the input to the instrument in its true sense on the 0.1 and 1 volt ranges, but in its inverted sense on all other ranges. The decimal point indicators in tubes V2 through V7 are controlled by transistor switches Q11 through Q16, which, in turn, are controlled by the range counter status.

3-57. The switches Q22 through Q26 are the main elements of the anode strobing control circuit. They are turned on sequentially by shift register signals A through E, beginning with signal A. The F signal ensures that the transistors are turned on only during the second half of each sub-period as defined in Figure 3-9. The output of these switches controls switches Q27 through Q31, which apply +200 volts dc to the anode of each readout tube.

3-58. The overrange indicator V2 is operated by transistors Q17 and Q18. These transistors are controlled by the 6-state cycle control shift register, the 16-state binary counter, and the range counter. The zero character in this tube is illuminated only when the range counter commands the 0.1 or 1 range, and when the bount in the binary counter is less than 10. The one character is illuminated when the count in the binary counter is 10 or 11. The decoder driver U4 is a monolithic BCD to decimal decoder which accepts the 4-bit BCD output of the 16-state binary counter, decodes each digital word, and selects one of ten output drivers. The cathodes of readout tubes V3 through V7 are connected in parallel. These ten anodes are, in turn, connected to the ten available outputs of the decoder driver.

3-59. The sample command oscillator (SCO) consists of Programmable Unijunction Transistor (PUT) Q8 and surrounding circuitry shown in Figure 3-10 in its normal operating state. Resistors R12 and R14 provide a bias level for the gate of the PUT. When capacitor C3 charges to approximately 0.6 volt above the gate bias level, the PUT turns on and discharges C3 through R15. This generates an output pulse which commands the measure/storage cycle J-K flip-flop U3A to the measure period to take a sample, providing the end of a ZERO pulse is coincident at the clocked input to the flip-flop. If the sample results in a command to autorange, signal 3 from the A2 Range Delay one-shot turns off Q6 and disables the SCO to allow time for analog signal conditions to settle on the new range before another sample is taken. Capacitor C4 begins to recharge and the SCO cycle begins again. The oscillator frequency is dependent upon the time constant of R and C3, and the gate bias level. The frequency is varied by the adjustment of R through the front panel SAMPLE RATE control. Transistor Q7 and its base bias network (R11 and R13) ensures that PUT Q8 is turned off by forcing the gate and anode to the same potential after C3 discharges.

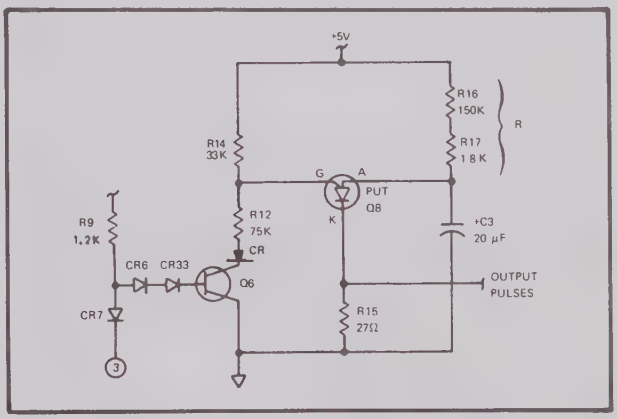


Figure 3-10. BASIC SAMPLE COMMAND OSCILLATOR

3-60. The remaining circuitry surrounding the SCO (See A14 Display schematic diagram) functions only when the SAMPLE RATE control is switched to the EXT position and samples are initiated through the external trigger input of the Data Output Unit (DOU) option. In this circumstance, the emitter of Q6 is normally high. Thus, the gate of PUT Q8 is near the supply voltage and the PUT Is disabled. A trigger from the DOU, however, pulls the emitter of Q6 to ground. Its collector follows, causing the gate of Q8 to be more than 0.6 volt below the anode and the PUT fires once. If the corresponding sample results in a range change, the range delay one shot multivibrator will disable the SCO via 3 and CR7. This means that no samples may be commanded until the range delay one-shot times out. At

the end of this time delay, the SCO is automatically retriggered via CR8 and 2 from the range delay one-shot. Diode CR9 and resistor R10 ensure that capacitor C3 is charged rapidly to ready the PUT for the next trigger pulse. Signal No. 8 interrupts the cycle control shift register on the A8 Logic board by forcing it directly to the E sub-period. This is done to minimize the time between the sample command (trigger) and actual sample.

3-61. The measure/storage cycle commands come from J-K flip-flop U3A on the A14 Display board. The clocked input of U3A is connected to ZERO through a bias and differentiating network composed of capacitor C4 and resistors R18, R19. When the M output of U3A is high, the instrument is in the measurement period of the measurement/storage cycle. When the M output from U3A is low, the storage period prevails. The clocked input is normally high as determined by the bias network, and since this is a master-slave type flip-flop, the master is connected directly to the J and K inputs and isolated from the outputs. If the SCO outputs a pulse, the J input goes high and causes the master to assume the true state. At the start of the next ZERO time, the clock pulses low causing the slave, and hence, the outputs, to assume the state of the master. That is to say, the output goes true and initiates a measure cycle. At the same time, the master is updated as a function of the new J and K inputs. Thus, at the start of the next ZERO time, the slave assumes the false state existing in the master, and the storage period is initiated. Not until the SCO pulses again will another measurement period be initiated. The idealized waveform output of the measure/storage cycle J-K flip-flop waveform No. 8, and its two input generating waveforms 6 and 7 are shown in Figure 3-9, Sheet 1.

3-62. The OVER RANGE DRIVER circuit is composed of programmable unijunction transistor (PUT) Q4, transistors Q4, Q5 and Q37, and associated circuitry. Transistor Q2, diode CR5, and resistors R2 and R4 are not part of the driver circuit but provide a delay in the speed at which the range delay one-shot multivibrator circuit, on the A2 Range Delay board, times out. The overrange driver PUT Q4 is turned on when its gate voltage is reduced about 0.6 volt relative to the anode voltage. The differential voltage developed across resistor R64, (tied between the gate and anode of the PUT) when the PUT conducts, causes transistor Q5 to turn on the OVER lamp in the function display annunciator. Q3 is turned on by the 12th output pulse from the CCO being applied to its base. Twelve output pulses from the CCO indicate greater than twenty percent overvoltage is being applied at the input of the instrument for a given range. However, even though turned on, transistor Q3 is ineffective in gating the PUT unless an enabling signal ($\overline{UP}$) is applied through R6 to its emitter. The source of the $\overline{UP}$ signal is the output of NAND gate U2A located on the A8 Logic board. Signal No. 7 is the UP range signal that is applied to NAND gate U3B on the A2 Range Delay board. It is generated at the emitter of transistor Q37 when this transistor is turned on by the PUT firing. After firing, the PUT is reset by the application of the positive-going edge of the M signal applied to its cathode through C1.

3-63. The RANGE COUNTER circuit is composed of J-K flip-flops U2A, U2B and U3B. The clocked input to the range counter is provided by J-K range flip-flop U3B, that has as its clocked input signal No. 6. This signal originates in the range oscillator on the A2 Range Delay board and is pulsed high everytime the range oscillator PUT fires. The J-K inputs to the range flip-flop U3B are tied together at the output of the measure/storage cycle J-K flip-flop U3A and go high every measurement period. The range counter is a divide-by-6 counter that provides the 6 possible binary states for range counting, 5 pulses being considered an up-range command and 1 pulse being considered a down-range command. Signal No. 6 applied to the clocked input of the range flip-flop U3B alters the 6 states of the range counter. Transistor Q35 is provided to pull the range counter out of an unallowed state that may occur at turn-on.

3-64. A2 Range Delay

3-65. The A2 Range Delay circuits (Drawing No. 8375A-1006) consists of a series of gates, a range delay one-shot multivibrator, and a range oscillator. The gates allow the specified set of ranges to be attained, which is dependent upon the function called on the front panel. The range oscillator generates pulses which trigger the range delay one-shot while simultaneously causing the A14 range counter to change states. The range delay one-shot prevents further ranging for a specified time to allow the analog signal conditioners to settle in the new range.

3-66. The gates are U2A, U2B, U2C, U3A and U3B. Gates U2C and U3A are up range stops which pull down on the range-up enable line. Gate U2C prevents autoranging above the 10,000 range, while gate U3A prevents autoranging above the 1000 range on the VDC function. Gates U2A and U2B are down range stops which pull down on the range-down enable line. Gate U2A prevents autoranging below the 10 range in the Ω function, while gate U2B prevent autoranging below the 0.1 range in any function. Gate U3B is the master up-range control. It enables the range oscillator only if an up range is to be expected.

3-67. The three inverters U1D, U1E and U1F coupled with the range-up enable line provide one input for up-range control gate U3B. The result is that U3B is enabled for 1.5 milliseconds (the second half of the A sub-period of a measurement period) if an up-range is to be executed. Signals applied to diodes CR6 through 8 and 10, coupled with the range-down enable line provide a negative going signal to the range oscillator at the end of the A sub-period of a measurement period if a down-range is to be executed. Thus, there are two ways which can enable the range oscillator.

3-68. The range oscillator is composed of capacitor C4, resistors R14 and R18, and Programmable Unijunction Transistor (PUT) Q4, with the output of this oscillator appearing at the cathode of PUT Q4. The PUT is fired, discharging capacitor C4 through R15, when the gate is about −0.6 volt relative to the anode. Thus the PUT is fired to produce one output pulse by lowering gate voltage or by raising the anode voltage, such that the voltage difference between these elements is indicated above. The firing of PUT Q4 discharges capacitor C4 and reduces the anode and gate voltages. This causes Q3 to turn on and force the anode and gate of Q4 to the same potential. Q4 turns off and capacitor C4 charges through R14 and R15. If the firing potential between the gate and anode of Q4 is established, Q4 again fires and the cycle is repeated to produce the second output pulse. The frequency of oscillations is set by the level of gate voltage applied and the charging time constant of R4, R18 and capacitor C4.

3-69. Control of the gate of PUT Q4 is effected by one of two mutually exclusive inputs. One of these is associated with ranging up and is identified on the A2 schematic as the output of gate U3B. The other of the two inputs is associated with ranging down and is identified as the range down enable line. In an up-range situation, the output of U3B pulls low for 1.5 milliseconds during which time the range oscillator outputs five pulses. In a down-range situation, the range-down enable line pulls low. This signal is capacitively coupled via C3 to the gate of PUT Q4 causing it to output one pulse. Five pulses counted by the A14 range counter commands a transition to the next higher range, while one pulse commands a transition to the next lower range. In either case, the first output pulse triggers the range delay one-shot to allow the analog signal conditioners to settle in the new range.

3-70. Transistors Q1, Q2 and associated components make up the range delay one-shot multivibrator. A range change pulse from the range oscillator applied to the base of transistor Q2 turns this transistor on and transistor Q1 off, thereby placing the one-shot multivibrator into its unstable state. The RC charge time of combined capacitors C2, C6 and resistor R5, and the current through R16 determine how long the one-shot remains in its unstable state. With the filter selected, no current flows through R16 and the time-out is about 220 milliseconds. Without the filter selected, the timeout is decreased to about 25 milliseconds because some current slows through R16. Signal No. 3 disables the sample command oscillator during the range delay time. Signal No. 2 re-triggers the SCO at the end of the range delay time.

3-71. Transistor Q5 and associated components is a circuit that prevents the instrument remaining in a disallowed range, as in 10,000 VDC, when turned on. When Q5 is turned on by the inputs of VDC and a. b. c., the collector of Q5 pulls down on the set line of the counter and thereby forces the instrument out of the 10,000 range.

3-72. A1 Power Supply

3-73. The A1 Power Supply (Drawing No. 8375A-1001) consists of four regulators, a +18 and −18 volt regulator, a 200 volts regulator and a 5 volts regulator. The purpose of the power supply is to furnish, to the instrument, all of its required operating power.

3-74. The +18 and −18 volt regulators obtain filtered dc voltage from the full-wave rectifiers consisting of diodes CR5 through CR8 and filter capacitors C2 and C5. The +18 volts regulator consists of operational amplifier U1 and series pass transistor Q3. The voltage reference for the +18 volts regulator is derived from reference amplifier U9 and temperature compensation transistor Q23 on the A8 Logic board. The −18 volts regulator consists of operational amplifier U2 and series pass transistor Q5. The −18 volt regulator is referenced to the +18 volts.

3-75. The +200 volt regulator is operated from a full-wave bridge rectifier and filter consisting of diodes CR1 through CR4 and capacitor C1. The reference for the +200 volt regulator is the +18 volts. Voltage variations are amplified in transistor Q2 and applied to series pass transistor Q1.

3-76. The +5 volt regulator is operated from a full-wave rectifier and filter consisting of CR10 through CR13 and capacitor C8. The reference for the +5 volt regulator is −18 volts. The series pass element is a compound-emitter follower composed of transistor Q8 driving power transistor Q6. Voltage variations which are detected by the sample string (R14, R15 and R17) are amplified by transistors Q7.

3-77. A12 Ohms Converter

3-78. The Ohms Converter (Drawing No. 8375A-1010) is operated in one of two configurations associated with the functions of OHMS and K OHMS. In the Ω function, the converter is a constant current source, and in the KΩ function, the converter is a precision scaling resistor, which in conjunction with the Buffer Amplifier and the unknown resistor, produces a voltage proportional to the unknown resistor. The constant current source produces one of three currents depending upon the range selected. These currents are as follows:

OHMS RANGE	CURRENT
10	10 mA
100	10 mA
1000	1 mA
10K	100 μA

3-79. In the constant current generator, regulated dc voltage is developed by resistors R2, R4, R5, zener diode CR3, transistor Q1 and operational amplifier U1. Divider string, R6, R7 and R8, scales the zener reference voltage and applies it to U2. Range resistors R10 through R16, in conjunction with zener CR3, the regulated dc voltage, and amplifier U2, apply a range dependent, constant current to the emitter of a Darlington pair composed of Q2 and Q3. Fuse F1, capacitor C6, and diodes CR2, CR4 are used as an overvoltage protection circuit for the current generator.

3-80. Resistors R17 through R22, and relay contacts K1–A, K2–A and K4 comprise the range scaling network. The relay contacts K1–A and K2–A are actuated by range selection on front panel. Relay K4 is actuated in the KΩ function and connects one end of the scaling network to the HI SOURCE terminal on front panel.

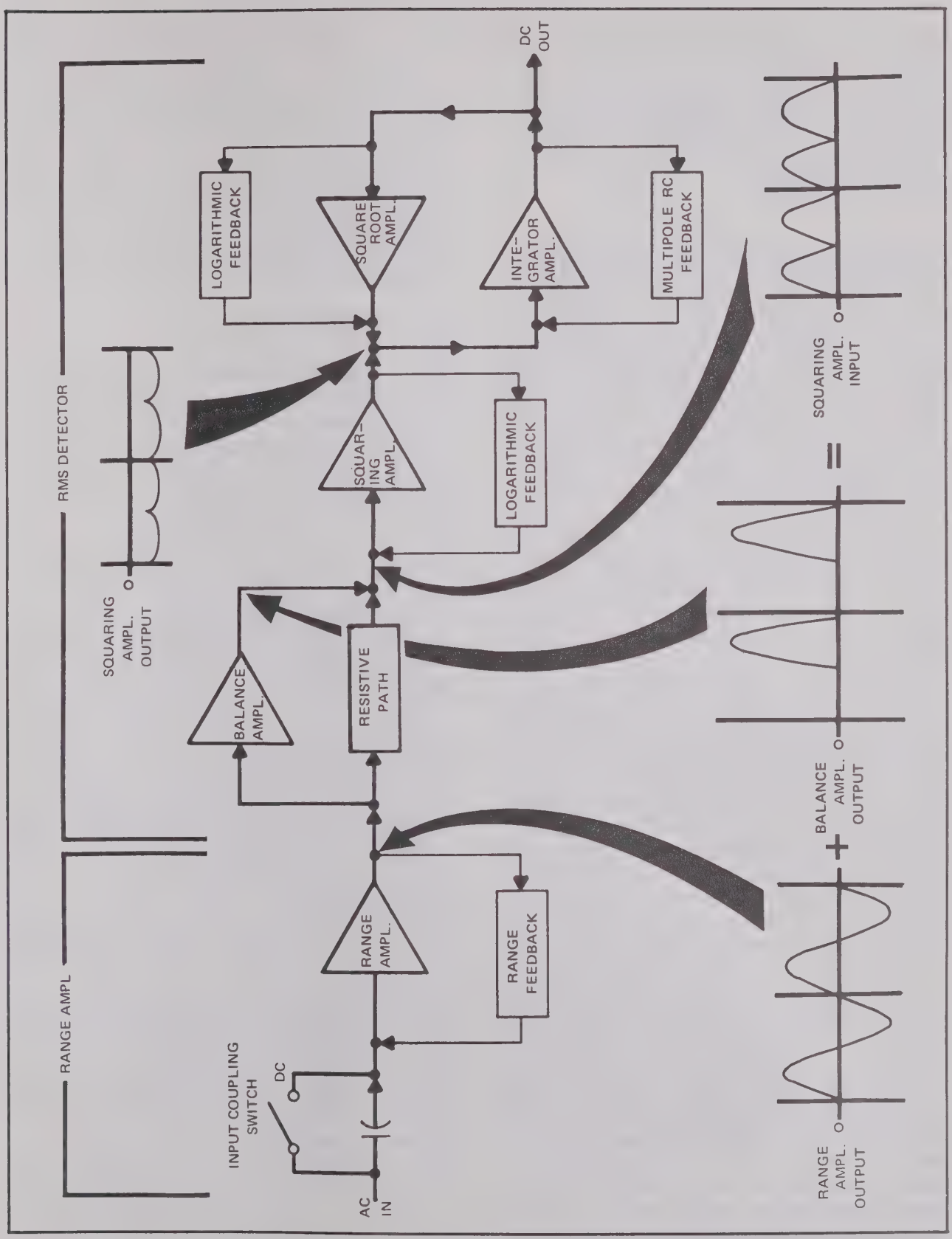
3-81. In the range relay drive circuit, range control relay K1 receives its commands from the A11 BUFFER assembly, whereas relay K2 receives its call commands from the buffered A14 range counter. Function control relays K3 and K4 are controlled by transistors Q6 and Q5, respectively. A manual range condition is detected by Gate U5B which enables gates U5C and U5D to control Q5 and Q6. In an autorange condition, gates U5C and U5D are disabled and function control is transferred by gate U3B to RS flip-flop U3A and U3C. The mutually exclusive outputs of this flip-flop, in turn, control switches Q5 and Q6. Gates U4A and U4B operate on the set and reset lines of the RS flip-flop to enable an automatic change of functions in an autorange condition.

3-82. A13 True RMS Converter

3-83. The True RMS Converter (Drawing No. 8375A-1022) provides a dc voltage, proportional to the rms value of the applied INPUT voltage, to the A/D Converter for digitizing and subsequent display on the front panel readout. A simplified diagram of the circuits involved in the rms conversion process is illustrated in Figure 3-11. As shown in the diagram, the RMS Converter consists, basically, of a Range Amplifier and RMS Detector. The output voltage from the Range Amplifier is 1 volt rms ac, maximum, for a full scale INPUT voltage. A scaled output voltage from the Range Amplifier is applied to the RMS Detector's Balance Amplifier where any negative going signals are inverted. The output of the Balance Amplifier is summed with the output of the Range Amplifier at the summing junction of the Squaring Amplifier. This provides a rectified version of the Range Amplifier output. The rectified signal is processed by the Squaring Amplifier, Integrating Amplifier, and Square Root Amplifier, respectively. These three amplifiers perform squaring, integrating, and square rooting functions which result in a dc voltage proportional to the rms value of the INPUT voltage.

3-84. The Range Amplifier scales the applied input voltage to the Converter to 1 volt rms ac for a full scale input. Basically, the Range Amplifier is an inverting operational amplifier whose gain changes as the range changes. Voltage gains of −1, −10, −100 and −1000 correspond with the 1 through 1000 volt ranges, respectively. Active elements of the Range Amplifiers are Q1, Q2, Q5 and U3 with protection diodes CR6, CR7, CR18, CR20, CR21 and CR22. Transistor Q2 drives the guard at the summing point of the operational amplifier, and Q5 switches C5 into feedback path in the 10, 100 and 1000 volt ranges. Diode CR6, CR7, CR21 and CR22 provide clipping for input overload protection to Q1. Diodes CR18 and CR20 provide overload clipping at the output of the Range Amplifier for protection of the following circuitry.

3-85. The Balance Amplifier is a rectifying amplifier with a gain of −1 that changes all negative going signals from the Range Amplifier output to positive voltages prior to summing with the Range Amplifier output from R33. Balance Gain adjustment (R32) controls the input to the Balance Amplifier, such that positive and negative signals at the summing junction of R31 and R33 will be equal in magnitude. Active components of the Balance Amplifier are CR15, Q6, Q9, Q10 and U4. Balance Zero Adjustment, R42, is an adjustment for zeroing the input of U4. The primary, or low frequency signal path is through U4, CR15, and final output stage Q10. At frequencies above a few


RMS DETECTOR
RANGE AMPL
DC OUT
LOGARITHMIC FEEDBACK
SQUARE ROOT AMPL.
INTE-GRATOR AMPL.
MULTIPOLE RC FEEDBACK
SQUARING AMPL. OUTPUT
SQUAR-ING AMPL.
LOGARITHMIC FEEDBACK
BALANCE AMPL.
RESISTIVE PATH
RANGE AMPL.
RANGE FEEDBACK
INPUT COUPLING SWITCH
DC
AC IN
SQUARING AMPL. INPUT
BALANCE AMPL. OUTPUT
RANGE AMPL. OUTPUT

hundred kilohertz, amplification takes place through Q6 followed by Q10. The final output stage, Q10, has a current source load, CL1, which maintains a high amplifier output impedance for driving CR14 and CR16. Any stray capacitance in CR14 and CR16 is compensated by Q9. Transistor Q9 samples the waveform driving CR14 and CR16 and feeds back a capacitive charge through C17 to the input of the Balance Amplifier.

3-86. The Squaring Amplifier is an inverting operational amplifier with non-linear feedback through matched transistors Q_{8A} and Q_{12A}. These transistors transform the input current into an output voltage that is the log of the input current. Since this operation is performed twice (by Q_{8A} and Q_{12A}), the output voltage is twice the log of the input current. Therefore, the amplifier essentially accomplishes a squaring operation ($2 \log X = X^2$). U_5 is an integrated operational amplifier which is paralleled by Q7 by high frequencies in a manner similar to Q6 in the Balance Amplifier. AC Zero Adjustment, R43, provides for zeroing of U5, and has the greatest effect of all other zero adjusts for overall converter zero. Both amplifying paths, U5 and Q7, share the common final output stage, Q11. Output voltage from Q11 is sampled by Q12B which provides a current to the summing point of the Integrator Amplifier. Resistor R38 provides an adjustment for crest factor gain.

3-87. The Integrator Amplifier consists primarily of U7 and U8, and is a complex multipole integrator which acts as a three pole filter. Voltage at terminal 2 of U7 is held at zero, and all of the current applied is passed through the feedback elements R56, R65 and whichever feedback capacitors are switched into the circuit. Switchable capacitors are connected through FET's Q13, Q14, Q16 and Q17 by operation of the FILT switch on the instrument front panel. If the FILT switch is depressed, the FET's are turned on, and the capacitors are a part of the feedback circuitry. Since each switchable capacitor is paralleled by a non-switchable capacitor, some filtering action takes place in the Integrator Amplifier whether the FILT is depressed or not. Amplifier U7 and associated multipole feedback circuitry provides the integration for the Integrator Amplifier. Amplifier U8 is a unity gain, high input impedance, low output impedance amplifier. Three poles of feedback for U7 consists of C30, R68 and C32, and R69 and C33. Capacitor C29 can be switched in parallel with C30, C34 with C32, C35 with C33, and C28 with C27. Output from U8 is the output of the total Integrator Amplifier which is then applied to the A-to-D Converter and to the Square Root Amplifier.

3-88. The Square Root Amplifier consists of the input resistor R57, the trimming and selection resistors R61, R62, R63, and R64, the feedback transistor Q8B, protection diode CR19, and amplifier U6. Diode CR19 acts as a feedback path to prevent saturation of U6 should input polarity to the amplifier reverse. The Square Root Amplifier uses logarithmetric feedback to produce a square root of the input in a manner similar to that used by the Squaring Amplifier. The square root process is accomplished by matched transistors Q8B and Q12B. Resistors R48, R79, and R80 are factory selected for overall converter TC and linearity. Some or none of these resistors may be installed.

3-89. Miscellaneous Circuitry

3-90. Input power to the instrument and interconnection of various assemblies is shown in the Wiring and Interconnect Diagrams (Drawing No. 8375A-1000 and 8375A-1100). Line power is fused by F1 and applied through the contacts of POWER switch S1 and T1. The primary of T1 consists of two windings which are parallel or series connected through slide switch S2 to allow operation from either a 115 or 230V ac line. When S2 is set to 115, the primary windings of T1 are connected in parallel. The 230 position of S2 connects the windings in series. Secondary windings of T1 provide ac voltages to the A1 Power Supply and A6 Data Output Unit No. 2. Shielding between the primary and secondary windings prevents coupling of any undesired line signals to the internal sections of the instrument.

3-91. TEST SWITCH

3-92. The Test Switch allows a partial check of instrument operation in Ohms, VDC, and VAC functions. The performance tests outlined in Section 4 of this manual give the procedures for a complete check of instrument operation for all ranges and function.

3-93. The Wiring Diagram (Drawing No. 8375A-1000) shows the connection for the Self Test Switch S1. The Test Switch positions, corresponding functions, and the expected readouts are listed in Table 2-2. The VDC position applies +18 volts dc from the Buffer to the Buffer input, the VAC position applies 13 volts ac from the Ohms Converter to the True RMS Converter input, and the Ohms position connects resistance across the Ohms Converter for measurement.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains information and instructions concerning preventive and corrective maintenance for the Model 8375A Digital Multimeter. The information and instructions are arranged under headings of "SERVICE INFORMATION, GENERAL MAINTENANCE, PERFORMANCE TEST, CALIBRATION PROCEDURE, COMPENSATING COMPONENT SELECTION, and TROUBLESHOOTING."

4-3. A calibration interval of 90 days is recommended to ensure instrument operation within the 90-day specifications as stated in Section 1.

4-4. Table 4-1 lists the required test equipment. If the recommended equipment is not available, other equipment having equivalent specifications may be used.

4-5. SERVICE INFORMATION

4-6. Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of the manual.

4-7. Factory authorized calibration and service for each Fluke product is available at various world-wide locations. A complete list of these authorized service centers is located at the rear of the manual. Shipping information is given in Section 2, paragraph 2-5. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-8. GENERAL MAINTENANCE

4-9. Access/Disassembly

4-10. The following procedure is used to gain access to the interior of the Model 8375A.

a. Remove top dust cover to gain access to calibration adjustments and test points.

b. Remove top guard chassis by removing the four screws which hold it in place. Access is now provided to the plug-in assemblies shown in Figure 4-1.

c. Remove bottom dust cover. By removing single screw securing bottom guard cover access can be gained to the bottom section of the Model 8375A.

Table 4-1. TEST EQUIPMENT

NOMENCLATURE	RECOMMENDED EQUIPMENT
AC Voltage Source	Fluke 5200A AC Calibrator and 5205A Power Amplifier
DC Voltage Source	Fluke 332D Voltage Standard
DC Differential Voltmeter	Fluke 885A Differential Voltmeter
RMS Differential Voltmeter	Fluke 931A True RMS Differential Voltmeter
Oscilloscope	Tektronix 544 with Type L Plug-In and Low Capacitance Probe
Pulse Generator	H–P 8003A Pulse Generator
Kelvin-Varley Divider	Fluke 720A Voltage Divider
Resistance Standard	General Radio Type 1440

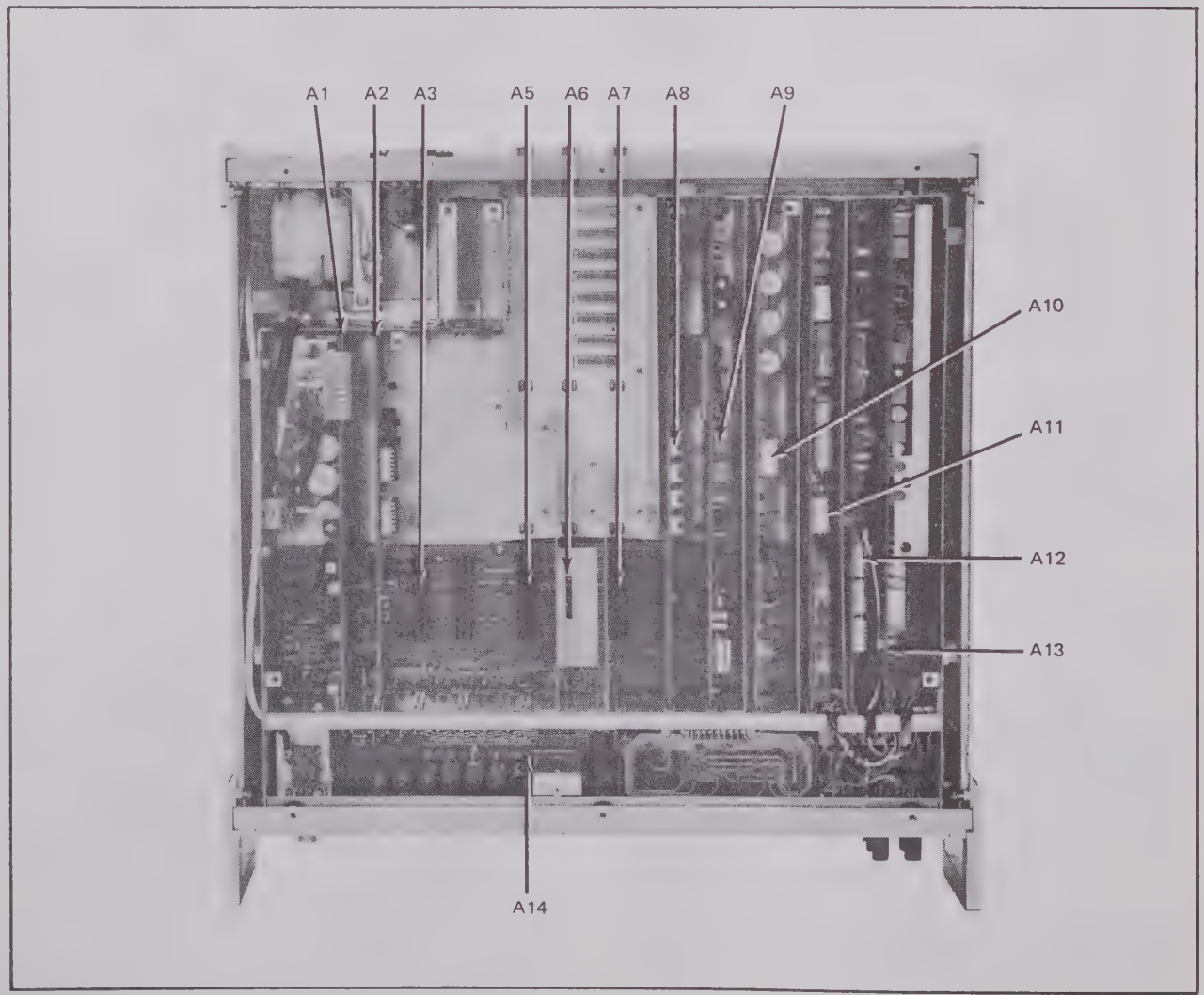


Figure 4-1. ASSEMBLY LOCATIONS

4-11. Cleaning

4-12. Clean the instrument periodically to remove dust, grease, and other contamination. Use the following procedure:

a. Clean the interior with clean, dry air at low pressure. When the printed circuit boards require cleaning, first spray them with Freon T.F. Degreaser (Miller Stephensen Company, Inc.) and then remove the dirt with clean, dry air at low pressure.

CAUTION!

Do not spray Freon T.F. on the component side of any PCB since damage to certain components may result.

b. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened in a mild solution of detergent and water.

CAUTION!

Do not use aromatic hydrocarbons or chlorinated solvents on the front panel, because they will react with the Lexan binding posts.

4-13. Fuse Replacement

4-14. One fuse is located in the rear panel fuseholder. When replacement is necessary, install Bussman, TYPE AGC ½A as shown on Decal located on the rear panel.

4-15. The Ohms Converter contains two fuses, one of which prevents damage in the event large ac or dc voltages are inadvertantly applied to the DMM input during ohms operation. The circuit will withstand a maximum applied voltage of 20 volts rms on 10Ω through 10,000Ω range before the fuse will blow. Up to 250V rms may continuously be applied to the 100kΩ through 10,000kΩ ranges without damage. A spare fuse is located on the ohms converter pcb, next to the in-circuit fuse.

4-16. Lamp and Tube Replacement

4-17. The readout tubes (V1 through V7) and the Function Display Lamps are mounted behind the left portion of the front panel. These components are replaced without special tools using the following procedure:

4-18. FUNCTION/DISPLAY LAMPS

4-19. Replace the function/display lamps as follows:

a. Remove top and bottom dust covers and inner guard chassis covers.

b. To replace the function display lamps remove the function display assembly mounting screws. Access to these mounting screws is from the bottom of the instrument.

c. Remove the function display assembly from the top of the instrument. After removal of the plexiglass cover on the assembly, the defective lamp may be replaced by carefully unsoldering the old lamp, clearing the holes of solder, and soldering in the new lamp.

CAUTION!

Use a desoldering tool and exercise extreme caution to avoid lifting land patterns.

4-20. READOUT TUBE REPLACEMENT

4-21. To replace the readout tubes unsolder the base mounting pins and remove tube from the top of the instrument. The SAMPLE RATE indicator (DS1) is located next to the SAMPLE RATE adjustment on front panel. Remove DS1 by desoldering both leads from A14 assembly, and pull lamp out from holder. Install and solder new lamp.

4-22. Removal of Display PCB (A14)

a. Remove the top and bottom dust covers and the top and bottom inner guard covers.

b. Set all switches to the nondepressed position.

c. Remove shorting links from INPUT terminals on front panel.

d. Remove knob from the SAMPLE RATE potentiometer.

e. Unplug and remove all plug in circuit assemblies from instrument.

f. Remove decals from the side of handles.

g. Remove four (4) screws on side of each handle. Remove the front panel from the instrument.

h. Disconnect wires from terminal posts to terminal block at the terminal block, and pull SAMPLE RATE lamp out from its holder.

i. Remove four (4) screws which secure the front sub-panel to the inner chassis and three (3) screws which secure DISPLAY PCB (A14) to front sub-panel. Remove front sub-panel.

j. Remove seven (7) mounting screws from the display PCB (A14).

k. Pull display PCB out from front of instrument.

4-23. Function Switches (Except Ext Ref, Filt) Disassembly

a. Perform steps a through d of paragraph 4-21.

b. Unplug P14 (flexible plug in circuit plug) from connector J14 on DISPLAY PCB.

c. Remove four (4) mounting screws which secure FUNCTION switches to switch assembly brackets.

d. Remove button on switch to be repaired by applying pressure to the rear of the button on pulling button away from switch. Note that on some instruments buttons are cemented on the switch shaft. When replacing buttons, use a small amount of contact cement. Apply cement to shaft only.

e. Pull FUNCTION switch assembly away from brackets.

f. Remove rear support bracket and lockouts by bending all locking tabs on rear support bracket, up (Figure 4-2).

g. Remove retaining ring and spring from switch shaft.

h. Insert a tool between the latch bar and switch shaft on adjacent switch (Figure 4-3).

i. Slide latch bar to edge of opening in front switch support bracket.

j. Holding latch bar open, push defective switch shaft out rear of module. Switch contacts will fall out of their slots when shaft is pushed out of module.

CAUTION!

Under no circumstances must attempts be made to re-form or add tension to the switch contacts by bending them.

k. Inspect the switch contacts for contamination and, if necessary, clean them with a clean swab saturated in alcohol. After cleaning, the contacts must be re-coated with a thin coat of grease: Use RYKON 2EP grease (American Oil Co.) or equivalent.

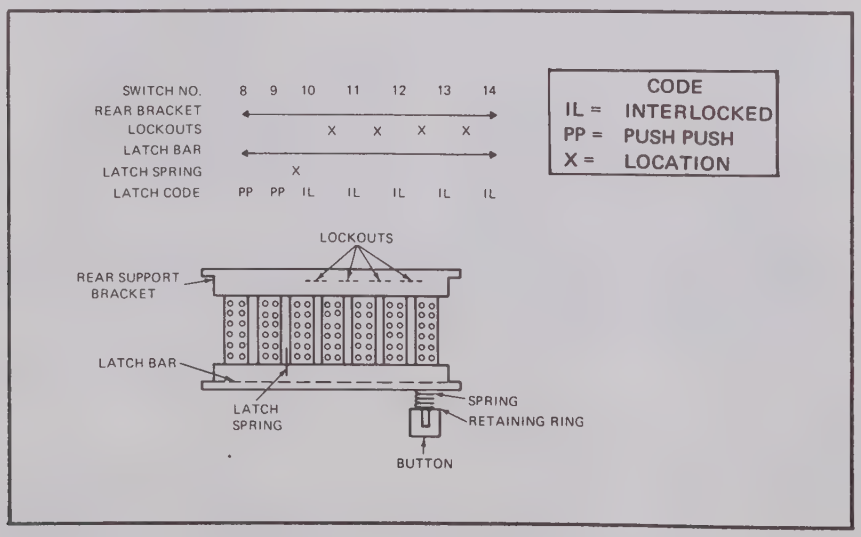


Figure 4-2. FUNCTION SWITCH ASSEMBLY

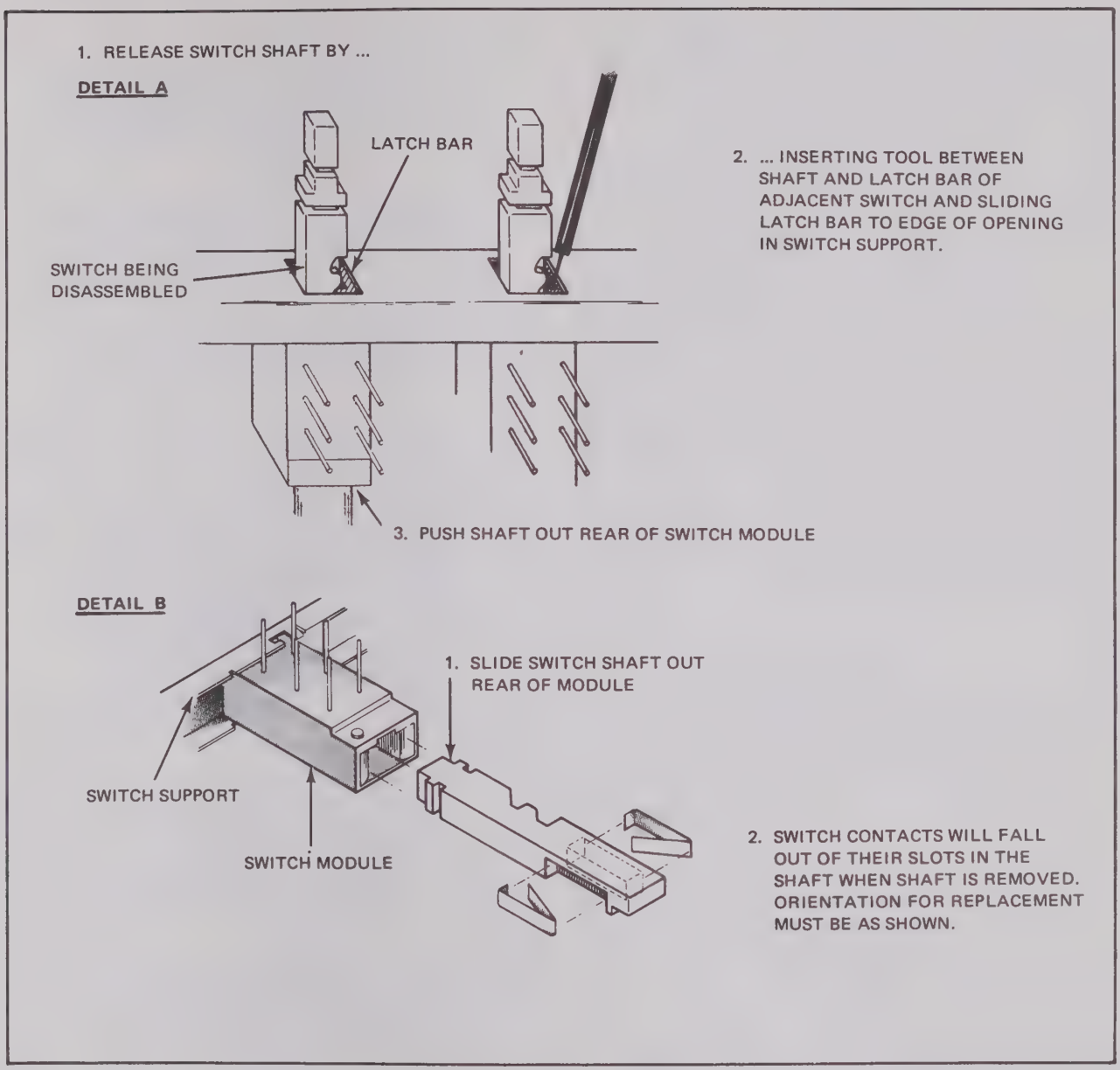

1. RELEASE SWITCH SHAFT BY ...
DETAIL A
LATCH BAR
SWITCH BEING DISASSEMBLED
2. ... INSERTING TOOL BETWEEN SHAFT AND LATCH BAR OF ADJACENT SWITCH AND SLIDING LATCH BAR TO EDGE OF OPENING IN SWITCH SUPPORT.
3. PUSH SHAFT OUT REAR OF SWITCH MODULE
DETAIL B
1. SLIDE SWITCH SHAFT OUT REAR OF MODULE
SWITCH SUPPORT
SWITCH MODULE
2. SWITCH CONTACTS WILL FALL OUT OF THEIR SLOTS IN THE SHAFT WHEN SHAFT IS REMOVED. ORIENTATION FOR REPLACEMENT MUST BE AS SHOWN.

Figure 4-3. PUSHBUTTON SWITCH DISASSEMBLY

4-24. Range Switches Disassembly

a. Perform steps a through d of paragraph 4-21.

b. Unplug P14 (flexible plug in circuit plug) from J14.

c. Remove U2 and U3, on Display PCB, from their sockets.

d. Remove four (4) mounting screws which secure RANGE switches to switch assembly brackets.

e. Pull FUNCTION switch assembly, with brackets, away from RANGE switch assembly.

f. Unsolder and remove J14 connector from Display PCB.

g. Straighten all locking tabs on rear support bracket (Figure 4-4).

CAUTION!

When straightening locking tabs avoid damaging land patterns on PCB.

h. Remove rear support bracket by sliding bracket to the right to clear switch module alignment pins. Remove bracket and lockouts.

i. Remove button, retaining ring and spring.

j. Insert a tool between the latch bar and switch shaft on adjacent switch (Figure 4-4).

k. Slide latch bar to edge of opening in front switch support bracket.

l. Holding latch bar open, push defective switch shaft out rear of module. Switch contacts will fall out of their slots when shaft is pushed out of module.

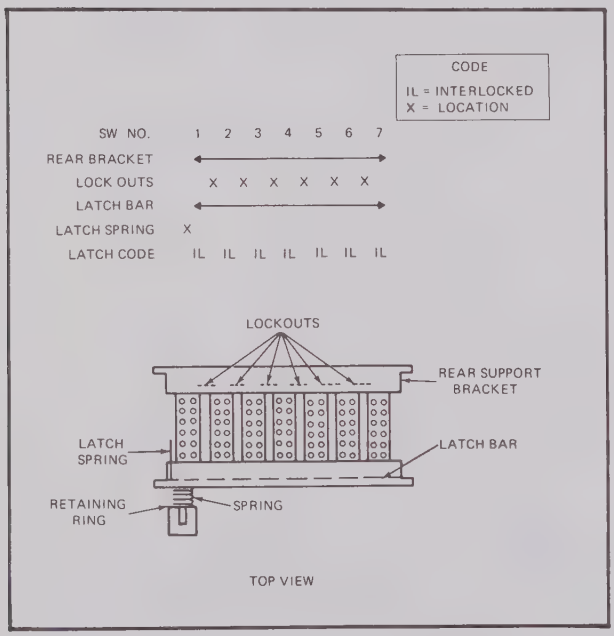


Figure 4-4. RANGE SWITCH ASSEMBLY

CAUTION!

Under no circumstances must attempts be made to re-form or add tension to the switch contacts by bending them.

m. Inspect the switch contacts for contamination and, if necessary, clean them with a cotton swab saturated in alcohol. After cleaning, the contacts must be re-coated with a thin coat of grease. Use RYKON 2EP grease or equivalent.

4-25. Function Assembly (Except Ext Ref, Filt) Switch Module Replacement

a. Perform steps a through d of paragraph 4-21.

b. Unsolder flexible printed circuit from all switches.

CAUTION!

Use a desoldering tool and exercise extreme caution to avoid lifting land patterns or otherwise damaging the flexible circuit assembly.

c. Unlock the locking tab on front switch support bracket and remove module (Figure 4-5).

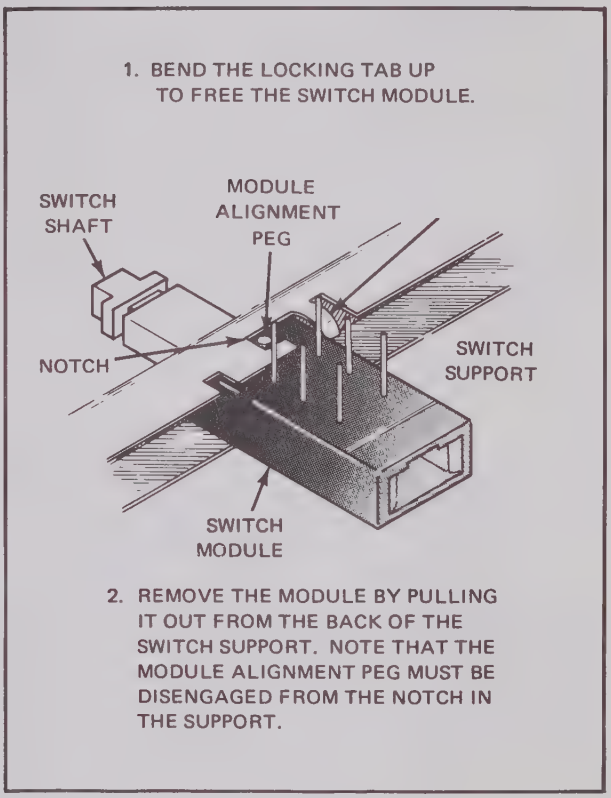

1. BEND THE LOCKING TAB UP TO FREE THE SWITCH MODULE.
SWITCH SHAFT
MODULE ALIGNMENT PEG
NOTCH
SWITCH SUPPORT
SWITCH MODULE
2. REMOVE THE MODULE BY PULLING IT OUT FROM THE BACK OF THE SWITCH SUPPORT. NOTE THAT THE MODULE ALIGNMENT PEG MUST BE DISENGAGED FROM THE NOTCH IN THE SUPPORT.

Figure 4-5. PUSHBUTTON SWITCH MODULE REPLACEMENT

d. Install new switch module by reversing the foregoing procedure.

CAUTION!

Under no circumstances must attempts be made to re-form or add tension to the switch contacts by bending them.

4-26. Range Assembly Switch Module Replacement

a. Perform steps a through d of paragraph 4-21.

b. Remove all buttons, retaining rings, springs and latch spring.

c. Unlock all locking tabs on front support bracket and remove front support bracket and latch bar.

d. Unsolder module that is to be replaced.

CAUTION!

Use a desoldering tool and exercise extreme caution to avoid lifting land patterns or otherwise damaging PCB.

e. Install new switch module by reversing foregoing procedure. Refer to Figure 4-4 for assembly of RANGE SWITCH assembly.

4-27. Ext Ref, Filt Switch Disassembly

a. Perform steps a through d of paragraph 4-21.

b. Unsolder defective switch from flexible circuit.

c. Remove push-push pin and push-push clip (Figure 4-6).

d. Remove switch shaft per Figure 4-3 Detail B.

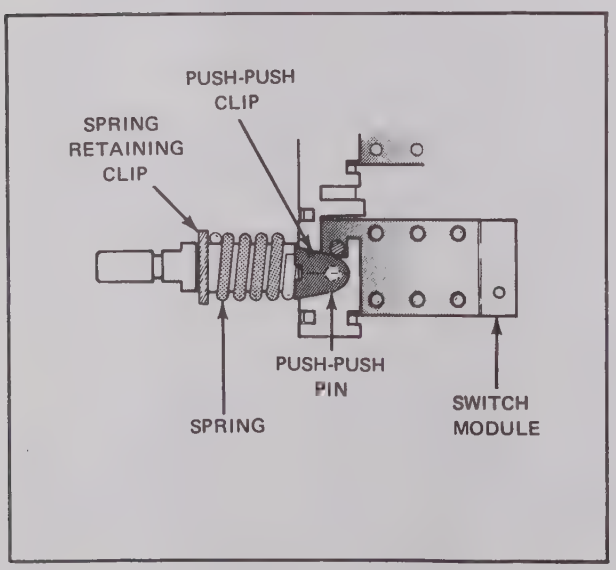


Figure 4-6. EXT REF AND FILT SWITCH DISASSEMBLY

CAUTION!

Under no circumstances must attempts be made to re-form or add tension to the switch contacts by bending them.

e. Inspect the switch contacts for contamination and, if necessary, clean them with a cotton swab saturated in alcohol. After cleaning, the contacts must be re-coated with a thin coat of grease: Use RYKON 2EP grease or equivalent.

f. Assemble the switch by reversing the foregoing procedure. Exercise caution to ensure the contacts are not deformed during assembly.

4-28. PERFORMANCE TEST

4-29. The performance tests should be conducted after failure of the instrument self-test (Test Switch) and prior to any instrument maintenance or calibration attempts. Known quantities are applied to the instrument input terminals on each of the functions and ranges, and proper operation of the circuitry is then checked. These tests are also suited to receiving inspection of new instruments. For proper conduction of the tests, an ambient temperature of 23°C ± 5°C, and a relative humidity of less than 70% is required.

NOTE!

Tolerances are derived from the 90-day instrument specifications contained in Section 1 of this manual.

4-30. DC Voltage Test

4-31. In the following procedure, dc voltages are applied to the instrument at 10% and 100% of full scale on the .1, 1, 10, 100 and 1000 volt ranges.

a. Connect the Model 8375A to the ac line and set the controls as follows:

POWER	ON
FUNCTION	VDC, FILT
RANGE	.1

b. Short the INPUT terminals.

c. Adjust the front panel ZERO control for a minimum reading on the Model 8375A display.

d. Connect equipment as shown in Figure 4-7.

e. Set the calibrator to 10.000V output on 10V range.

f. Refer to Table 4-2 for K-V divider settings and corresponding readout limits on Model 8375A.

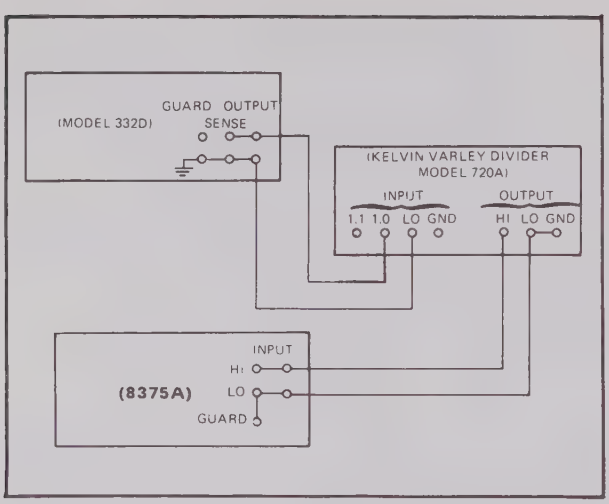


Figure 4-7. READOUT CHECK EQUIPMENT CONNECTION

Table 4-2. DC TEST REQUIREMENTS (.01V to 1V)

K-V DIVIDER SETTINGS	MODEL 8375A	
	RANGE	READOUT LIMITS
.0010000	.1	+.009994 to .010006
.0100000	.1	+0.99989 to 1.00011
.0100000	1	+0.09997 to 0.10003
.1000000	1	+0.99992 to 1.00008
.1000000	10	+0.9998 to 1.0002

g. Reverse input leads to Model 8375A.

h. Repeat step f. The DMM readout must be the same as for positive inputs, except that the polarity indication will be negative (–).

i. Disconnect equipment and connect calibrator to Model 8375A.

j. Apply each of the input voltages shown in Table 4-3 to the INPUT terminals of the Model 8375A. The readout must be as indicated.

k. Repeat step j with negative input voltages. The DMM readout must be the same as for positive inputs, except that the polarity indication will be negative (–).

l. Apply zero volts to the INPUT terminals of the DMM and depress the AUTO RANGE switch. The readout must be .000000 ± .000005.

Table 4-3. DC TEST REQUIREMENTS (10V, 100V, AND 1000V)

INPUT (Volts DC)	MODEL 8375A		
	RANGE	READOUT LIMITS	READOUT TOLERANCES
+10.0000	10	+9.9994 to 10.0006	±.0006
+10 0000	100	+09.998 to 10.002	±.002
+100.000	100	+99.994 to 100.006	±.006
+100.000	1000	+099.98 to 100.02	±.02
+1000.00	1000	+999.94 to 1000.06	±.06

m. Apply +1000.00 volts dc to the INPUT terminals. The DMM must range automatically and the readout must be +1000.00 ± .05.

4-32. Kilohms Test

4-33. The kilohms function is checked at full scale on each of three ranges of the DMM. Connect each of the standard resistors shown in Table 4-4, in turn, to the INPUT terminals of the Model 8375A. Use short, low-resistance connecting leads. Set the DMM controls as shown in the Table. The readout should be as indicated.

Table 4-4. KILOHMS TEST REQUIREMENTS

STANDARD RESISTANCE	MODEL 8375A		
	FUNCTION	RANGE	READOUT LIMITS
100KΩ	KΩ	100	99.988 to 100.012
1000KΩ	KΩ	1000	999.88 to 1000.12
10MΩ	KΩ	10K	9994.8 to 10005.2

4-34. Ohms Test

4-35. The ohms function is checked at full scale on each of four ranges on the DMM. Connect equipment as shown in Figure 4-8. Connect each of the standard resistors in Table 4-5, observing the appropriate readout as indicated.

4-36. RMS Voltage Test

4-37. Refering to Table 4-6, apply each of the rms voltages from the ac voltage source (and at the specified frequencies) to the Model 8375A INPUT terminals. Observe the appropriate readout to be within the tolerance limits listed in Table 4-6.

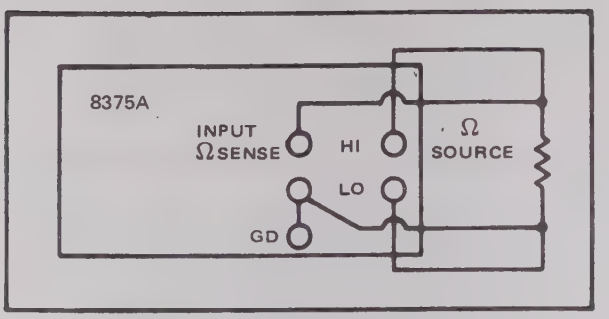


Figure 4-8. EQUIPMENT CONNECTIONS FOR OHMS TEST

Table 4-5. OHMS TEST REQUIREMENTS

STANDARD RESISTANCE	MODEL 8375A		
	FUNCTION	RANGE	READOUT LIMITS
10Ω	Ω	10	9.9980 to 10.0020
100Ω	Ω	100	99.987 to 100.013
1KΩ	Ω	1000	999.87 to 1000.13
10KΩ	Ω	10K	9998.7 to 10001.3

Table 4-6. RMS VOLTAGE TEST

INPUT VOLTAGE (RMS VOLTS)	FREQUENCY	RANGE	TOLERANCE
500.0	500Hz	1000	±0.7
500.0	50kHz	1000	±1.6
1.0000	500Hz	1	±0.0012
1.0000	50kHz	1	±0.004
10.000	50Hz	10	±0.012
10.000	50kHz	10	±0.04
100.00	500Hz	100	±0.12
100.00	50kHz	100	±0.4

4-38. CALIBRATION PROCEDURE

4-39. Introduction

4-40. The Model 8375A should be calibrated annually in order to maintain rated accuracy, or whenever repairs have been made. Calibration should be performed in an environment having an ambient temperature of 23°C ±2°C, and a relative humidity of less than 70%. Refer to Table 4-1 for recommended test equipment. Adjustment and test point locations are labeled on the top inner guard cover. Figure 4-9 shows adjustments and test point locations on the top inner guard cover.

4-41. Preliminary Operations

a. Remove the top dust cover screws, but leave the cover in place.

b. Set the 115/230 volt switch on the rear panel to 115 and then connect line cord to the output of an autotransformer set to 115V ac.

c. Turn on the Model 8375A and allow one hour for warm-up.

4-42. Buffer Zero Adjustment

a. Set the Model 8375A controls as follows:

FUNCTION VDC, FILT
RANGE .1

b. Short the INPUT terminals.

c. Adjust front panel ZERO control for a reading of ZERO ± 1 digit.

d. Remove the top dust cover.

4-43. Bias Current Adjustment

a. Remove short across input terminals and replace with 1 megohm resistor in parallel with a .22μf capacitor.

b. Adjust BIAS (A11R17) on A11 for a zero ±3 digit readout on the Model 8375A display.

c. Repeat steps 4-42 b and c.

4-44. Reference Voltage Adjustment

a. Connect the differential voltmeter to LO SENSE (A9TP7) and HI SENSE (A9TP5).

b. Adjust REF (A8R57) for a reading of 7.00000 ±25μV on the differential voltmeter. Remove short from the INPUT terminals.

4-45. A-D Zero Adjustment

a. Connect the HI of the voltmeter to CAL OUT (A9TP3).

b. Set the differential voltmeter as follows:

RANGE	1V
NULL SENSE	.1
READOUT	.550000

c. Set the Model 8375A as follows:

FUNCTION	VDC FILTER
SAMPLE RATE	FULL CW
RANGE	10

d. Connect test equipment as shown in Figure 4-9.

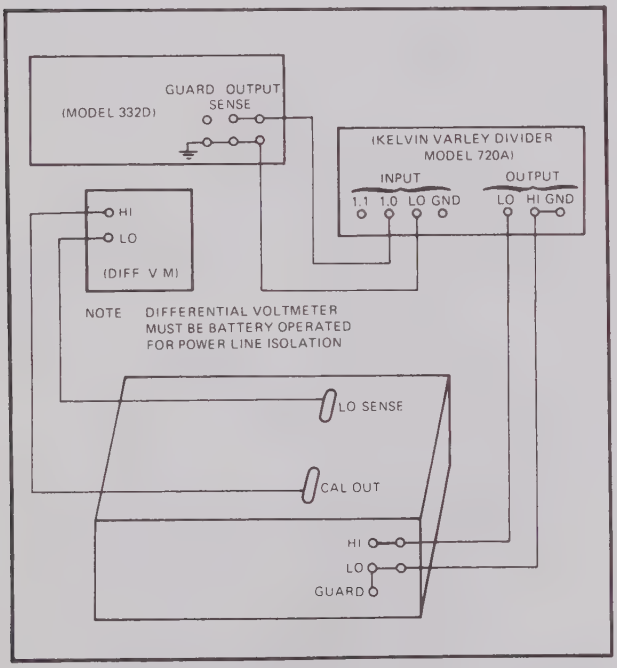


Figure 4-9. EQUIPMENT CONNECTION FOR CALIBRATION

e. Set the calibrator to 10.0000V output on 10V range and dial .00005 on 720A.

f. Adjust A-D ZERO (A11R37) for a readout of +0.0005V on the Model 8375A nixie display. Refine the adjustment for a null (zero) reading on the differential voltmeter. Reverse the input to the Model 8375A and observe −0.0005V on the display and that the reading on the differential voltmeter changes less than ±4 major divisions.

4-46. + Cal Adjustment

a. Connect equipment as shown in Figure 4-9.

b. Adjust COMPARATOR LEVEL (A9R61) to full cw.

c. Dial .800052 on divider.

d. Adjust +CAL (A11R17) for a readout of +8.0005 on Model 8375A display.

e. Refine the adjustment for a null (zero) on the differential voltmeter.

4-47. Ladder Cal

a. Connect equipment as shown in Figure 4-9.

b. Apply the input voltages given in Table 4-7 and perform the associated adjustments that produce the required readout on the Model 8375A and differential voltmeter.

Table 4-7. LADDER CALIBRATION

LADDER NO.	MODEL 8375A			DIFF. V/M
	K-V Divider	Adjustment	READOUT	READOUT
4	+.400052V	LADDER 4 (A9R45)	+4.0005V	NULL
2	+.200052V	LADDER 2 (A9R48)	+2.0005V	NULL
1	+.100052V	LADDER 1 (A9R50	+1.0005V	NULL

4-48. Negative Cal Adjustment

a. Set divider to .8000520.

b. Reverse input to the Model 8375A.

c. Adjust −CAL (A9R14) for a display readout of −8.0005.

d. Refine the adjustment for a null (zero) on the differential voltmeter.

4-49. Remainder Adjustment

a. Set COMPARATOR LEVEL (A9R61) full ccw.

b. Connect equipment as shown in Figure 4-9.

c. Apply the input voltages given in Table 4-8 and perform the associated adjustments that produce the required readout on the Model 8375A and differential voltmeter.

Table 4-8. COMPARATOR LEVEL ADJUSTMENT

DIGIT NO.	MODEL 8375A			
	K-V Divider SETTING	Adjustment	READOUT	DIFF. V/M READOUT
2	+.090052V	2nd Digit Remainder (A9R58)	+0.9005	NULL
3	+.099052V	3rd Digit Remainder (A9R56)	+0.9905	NULL
4	+.099952V	–	+0.9995	±2 Major Divisions

4-50. Comparator Level Adjustment

a. Connect equipment as in Figure 4-10, but do not make the differential voltmeter connections.

b. Set divider to .099995.

c. Adjust COMPARATOR LEVEL (A9R61) so display readout alternates between +0.9999 and +1.0000.

d. Alternate a dc input to the Model 8375A between +1.9999V and +2.0000V dc and verify that the display readout corresponds.

4-51. RMS Converter Adjustment

4-52. RANGE AMPLIFIER ZERO

a. Short the HI and LO INPUT terminals. Select VAC, FILT, and 10 RANGE pushbuttons. Place AC-DC switch on RMS converter to DC. This switch is accessible through the top guard cover.

b. Connect high lead of a dc voltmeter to the body of C11 (10V 50kHz adjustment) via a 10k isolation resistor. Connect low lead to the 8375A LO INPUT terminal

c. Adjust R12 (Range Zero Adjust) for external voltmeter indication of 0 ±30μV.

d. Remove external voltmeter and INPUT short.

4-53 BALANCE AMPLIFIER ZERO

a. Apply –0.1V dc to INPUT terminals from dc voltage source. Note 8375A reading.

b. Reverse input voltage polarity to +0.1V dc.

c. Adjust R42 (Balance Zero Adjust) for reading noted in step a.

d. Repeat steps a and b until difference between readings for each polarity is within 10 digits.

4-54. BALANCE GAIN

a. Apply –10V dc to INPUT terminals. Note 8375A reading.

b. Reverse input voltage polarity to +10V dc.

c. Adjust R32 (Balance Gain Adjust) for 8375A reading equivalent to step a.

d. Repeat steps a through c until difference between readings for each polarity is within 10 digits.

e. Remove dc voltage source.

4-55. AC ZERO

a. Select 1 RANGE and AC INPUT COUPLING. Apply 0.001 volts at 500Hz to INPUT terminals.

b. Adjust R45 (AC Zero Adjust) for reading of .00100 ±3 digits.

c. Remove AC input voltage.

4-56. CALIBRATION ADJUSTMENT/CHECK

4-57. Before performing calibration, allow one hour for warm-up with outer covers installed. Referring to Table 4-9 apply each of the rms voltages at the specified frequencies to the INPUT terminals and if necessary, perform the indicated adjustments to complete the calibration. If R64 (1000V, 500Hz adjustment) is not within adjustment range, refer to Course Calibration.

4-58. COURSE CALIBRATION

4-59. Perform the following procedure only when R64 is out of adjustment range.

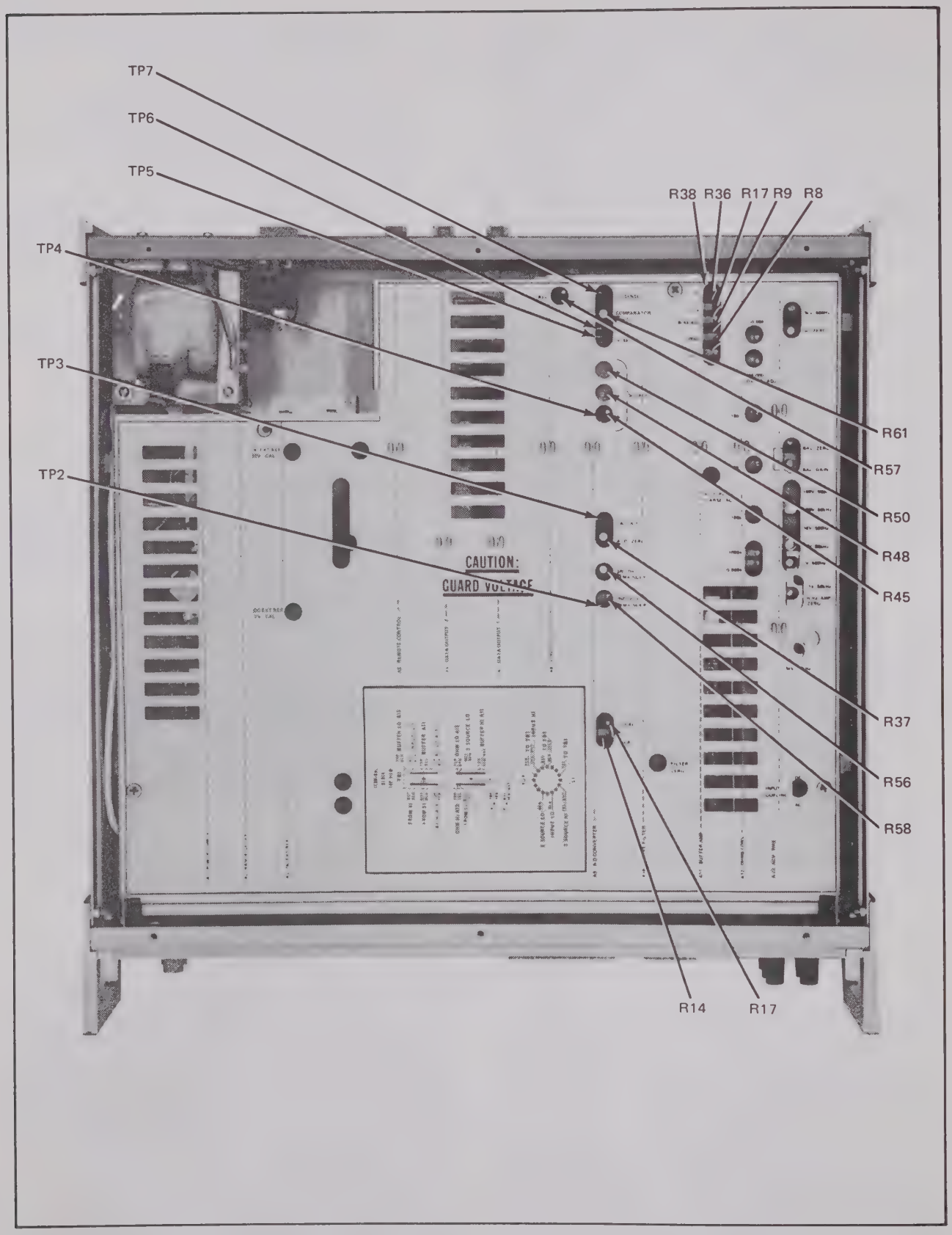


Figure 4-10. ADJUSTMENTS AND TEST POINT LOCATIONS

Table 4-9 CALIBRATION ADJUSTMENT/CHECK

INPUT		RANGE	ADJUSTMENT		TOLERANCE
VOLTAGE (RMS)	FREQUENCY		NAME	REF DESIG.	
500.0	500Hz	1000	1000V 500Hz	R64	± 10 Digits
500.0	50Hz	1000	1kV 50kHz	C4	
1.0000	500Hz	1	1V 500Hz	R14	
1.0000	50kHz	1	1V 50kHz	C9	
10.000	50Hz	10	10V 500Hz	R16	
10.000	50kHz	10	10V 50kHz	C11	
100.00	500Hz	100	100V 500Hz	R18	
100.00	50kHz	100	100V 50kHz	C14	

a. Connect any opened shorting links (1, 2 or 4) across course calibration resistors R61, R62 or R63.

b. Select the 1000 volt range and apply 500V at 500Hz to the INPUT terminals.

b. Adjust the "1000V, 500Hz" control (R64) for a minimum reading.

d. Cut open the appropriate link or links as indicated below depending upon the 8375A reading.

READING	CUT LINKS
465.7 - 470.1	1, 2, 4
470.1 - 474.3	2, 4
474.3 - 478.7	1, 4
478.7 - 482.5	4
482.5 - 486.9	1, 2
486.9 - 491.1	2
491.1 - 494.5	1
495.5 - 500	NONE

e. Repeat the Calibration Adjustment/Check, paragraph 4-56 to complete calibration.

4-60. Buffer DC Calibration

a. Apply the dc input voltages given in Table 4-10 and adjust the associated control for a corresponding readout.

b. Disconnect test equipment and replace top cover.

4-61. COMPENSATING COMPONENTS SELECTION

4-62. The replacement of components Q5, U1 and R22 through R27 in the Buffer Assembly will cause a deterioration of the temperature coefficient specification. If one or all of these components is found to be faulty the Buffer Assembly PCB must be returned to the factory for repair and recalibration.

Table 4-10. BUFFER CALIBRATION

DC INPUT VOLTAGE	MODEL 8375A		
	RANGE	ADJUSTMENT	READOUT
+100.000	100	100V (A11R8)	+100.000
+1000.00	1000	1000V (A11R9)	+1000.00
+1.00000	1	1V (A11R36)	+1.00000
+.100000	.1	0.1V (A11R38)	+.100000

4-63. Active Filter

4-64. If either Q1 or U2 are replaced in the Active Filter (A10), R11 or R12 may need to be selected in order to bring the required offset correction within the range of zero control R13. This is done as follows:

a. Depress VDC and 10 buttons on Model 8375A.

b. Short the 8375A INPUT terminals.

c. Short TP1 to TP2 on Active Filter PCB.

d. Install jumpers across R11 and R12 in positions W1 and W2.

e. Turn instrument on by depressing POWER button.

f. Observe the Model 8375A readout.

g. Select the proper offset resistor using Table 4-11.

Table 4-11. OFFSET CORRECTION RESISTOR SELECTION

8375A READOUT	RESISTANCE REQUIRED	JF PART NO.
0 – .0004	NONE	– –
.0005 – .0012	6.81k	268417
.0013 – .0020	13.7k	236752
.0021 – .0028	21.0k	229484
.0029 – .0036	28.7k	235176
.0037 – .0044	35.7k	288480
.0045 – .0052	44.2k	271676

h. Install resistor in location R11 if readout polarity is positive (+) or R12 if readout polarity is negative (–). Remove only the jumper wire for location used.

4-65. OHMS CONVERTER ADJUSTMENTS

4-66. Preliminary Operations

a. Set the Model 8375A controls as follows:

FUNCTION	VDC, FILT
RANGE	.1
SAMPLE RATE	full clockwise

b. Connect the GUARD terminal to the LO INPUT terminal and the HI SOURCE terminal to the HI INPUT terminal, and the LO SOURCE terminal to the LO INPUT terminal using the shorting links provided with the instrument.

c. Short the INPUT terminals together.

d. Adjust the DC ZERO control on the front panel for a readout of zero ± 1 digit.

4-67. Kilohms Calibration

a. Depress 10K and KΩ buttons.

b. Remove the short between the INPUT terminals.

c. Connect the resistances indicated in Table 4-12 between the INPUT terminals and perform the corresponding adjustment.

NOTE!

The readout indicated in Table 4-12 should match the exact value of the calibration resistor, not the nominal value.

Table 4-12. KΩ RANGE CALIBRATION

RESISTANCE	RANGE	ADJUSTMENT	READOUT
10M	10K	10000K (A12R17)	10000.0
1M	1000	1000K (A12R19)	1000.00
100K	100	100K (A12R21)	100.000

4-68. Ohms Calibration

a. Remove shorting links between the INPUT HI and SOURCE HI binding posts, and between INPUT LO and SOURCE LO binding posts.

b. Connect equipment as shown in Figure 4-8.

c. Depress Ω and 10K buttons on Model 8375A.

d. Connect the resistance, indicated in Table 4-13, as shown in Figure 4-8 and perform the corresponding adjustment.

e. Re-install shorting links.

4-69. Calibration of the Ohms converter is now complete.

Table 4-13. OHMS RANGE CALIBRATION

RESISTANCE	RANGE	ADJUSTMENT	READOUT
10K	10K	10000Ω(A12R7)	10000.0
1K	1000	1000Ω(A12R14)	1000.00
100Ω	100	100Ω(A12R10)	100.000
10Ω	10	NONE	10.000 ±.006*
NOTE* IF MORE THAN ±.006 RESET VDC ZERO AND RECALIBRATE OHMS RANGES			

4-70. TROUBLESHOOTING

4-71. Introduction

4-72. The information in the following paragraphs is provided to assist in locating troubles in the Model 8375A. Figure 4-10 shows assembly location by reference number

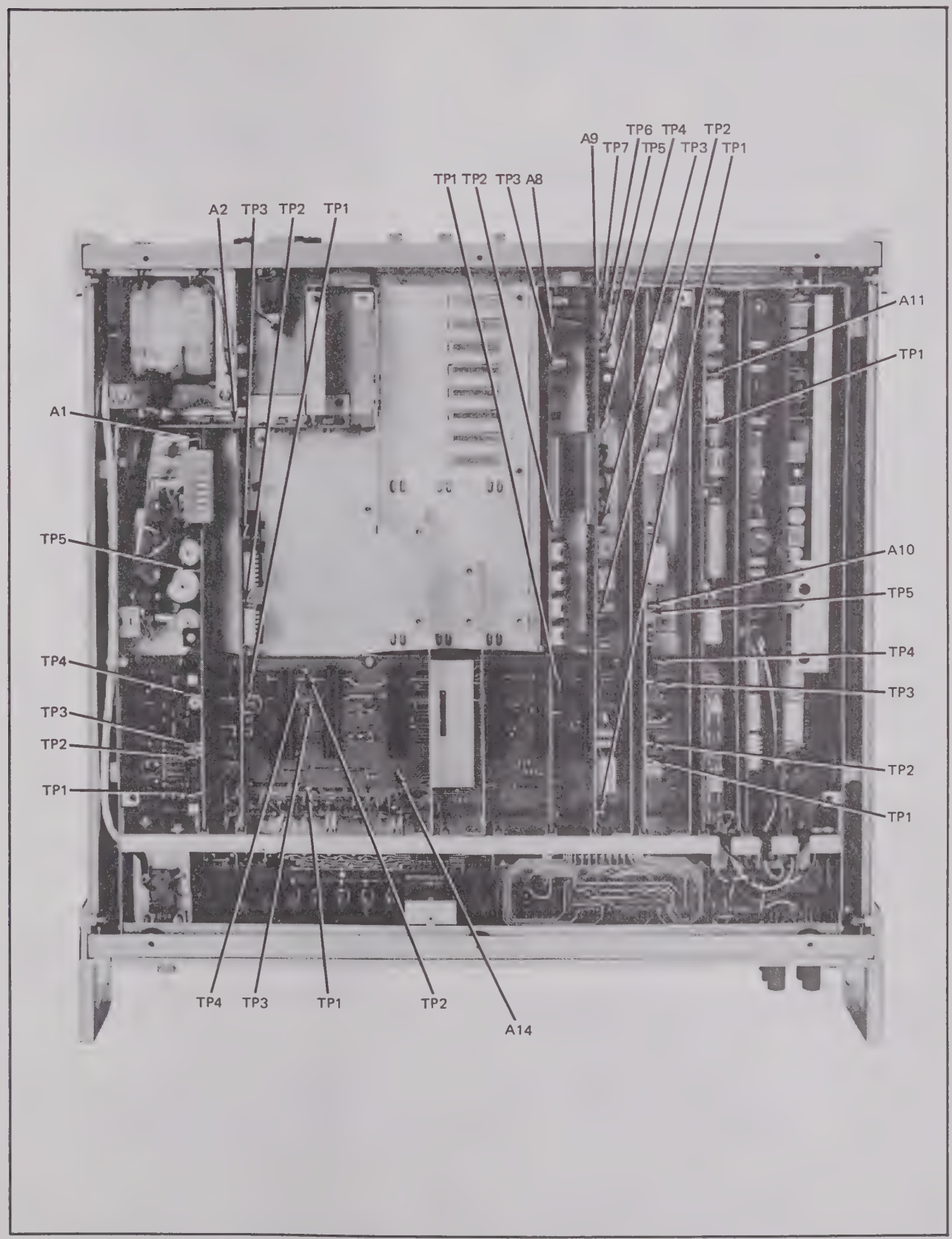


Figure 4-11. ASSEMBLY AND TEST POINT LOCATIONS

and test point locations. Since this instrument is somewhat complex, it is recommended that the theory of operation in Section 3 be understood before any attempt at troubleshooting is undertaken.

4-73. Initial Troubleshooting

4-74. Troubleshooting of the Model 8375A starts by first inspecting the instrument for improperly seated plug-in assemblies, loose wires, physically damaged parts, or other obvious problems. The next step is then to ensure that it is being operated correctly, but still fails to meet specifications. Performance checks designed for this purpose are given beginning at paragraph 4-28.

4-75. Section Localization

4-76. To aid in troubleshooting the Model 8375A, the basic instrument can be broken down into three major sections. An analog section consisting of the Buffer, Active Filter, Ohms Converter, and True RMS Converter supply a dc voltage from +10 to −10 volts, dependent upon the polarity and value of the input, to the digital section. The digital section, composed of the A-to-D Converter, Range Delay, and Display assemblies, converts the dc input from the analog section to a digital signal, then processes this signal through timing, storage, and display circuits for proper readout. The third section is a Power Supply Assembly which supplies operating voltages to the internal circuits of both the analog and digital sections.

4-77. Power Supply

4-78. The A1 Power Supply can be checked for proper operation using a dc differential voltmeter and performing the voltage checks given in Table 4-14.

Table 4-14. POWER SUPPLY CHECKS

VOLTAGE TEST POINTS		DC VOLTS		
V/M Lo	V/M Hi	NOMINAL	LIMITS	ADJUSTMENT
A1TP4	A1TP2	+18V	±10 mV	A1R11
A1TP4	A1TP3	−18V	±375 mV	NONE
A1TP4	A1TP5	+5V	+.15V	Remove R17 to increase
A1TP4	A1TP1	+200V	±5V	NONE

4-79. Analog Section

4-80. To determine if a trouble exists in the analog section, use the following checks:

a. Connect a battery powered differential voltmeter LO to (A10) TP4 and HI to (A10) TP3.

b. Depress VDC and 10 switches on Model 8375A.

c. Turn on the Model 8375A and apply +10V dc to INPUT terminals. The differential voltmeter should read −10V.

NOTE!

The differential voltmeter should read −10V for full range inputs on the 10, 100, and 1000 volt ranges, and +10V for full range inputs on the .1 and 1 volt ranges. For inputs less than full range, the differential voltmeter should read proportionately less.

(Example: +10V input on 100V range, the differential voltmeter will read −1V)

FAULT ANALYSIS

If voltmeter readings do not correspond to input voltages, the trouble exists in the analog section. If voltmeter readings do correspond to input voltages, the trouble exists in the digital section.

4-81. BUFFER CHECKS

4-82. Overload Check

a. Connect differential voltmeter HI to K1 pin 14 and LO to the Model 8375A HI (red) INPUT terminal.

b. Depress the 1 range, VDC, and FILT buttons. Set the SAMPLE RATE full cw.

c. Apply +3V ±1% to INPUT terminals of 8375A and observe readout of +1.19999. The differential voltmeter should read −.5V ± .25V.

FAULT ANALYSIS

If readings do not correspond, the probable cause is in the overload circuitry. The amplifier section may be a secondary cause.

4-83. Zero Check

a. Depress .1 range and VDC buttons on Model 8375A.

b. Short the INPUT terminals on front panel.

c. The display should indicate zero volts.

d. Adjusting the front panel DC Zero control in both directions should cause the display to vary from +.000030 to −.000030.

FAULT ANALYSIS

If the DC Zero control will not swing through Absolute Zero, adjustment of course DC Zero (A11R28) is indicated. If this is necessary, the amplifier section of the buffer could be faulty.

NOTE!

The BUFFER assembly must be returned to factory for replacement of faulty parts within the amplifier circuitry. Refer to paragraph 4-61 for critical components.

4-84. Gain Check

a. Depress the 10 range and VDC buttons on Model 8375A.

b. Connect a battery powered differential voltmeter as follows:

HI to INPUT HI on Model 8375A
LO to A11TP2

c. Apply −12.5V ± .5V to INPUT terminals of the 8375A.

d. The 8375A display should be −11.9999.

e. Differentially measure the voltage level between A11TP2 and INPUT HI.

f. Reverse the polarity of the input voltage and observe the following:

1. The 8375A readout is now +11.9999.

2. The differential voltmeter reading has changed less than +25μV.

FAULT ANALYSIS

If the Buffer checks are ok, the analog problem can be in the active filter circuitry.

4-85. ACTIVE FILTER CHECKS

4-86. Gain Checks

NOTE!

Remove the Remote Control Unit (−04 option) if the 8375A is so equipped.

a. Depress the REMOTE button on the 8375A.

b. Connect a battery powered differential voltmeter LO input lead to A10TP5 and HI lead to A10TP3.

c. Differentially measure the voltage level.

d. Apply +10V dc ±1V between A10TP4 (common) and A10TP5. The differential voltmeter indication should not change more than 100μV.

e. Reverse the polarity of input voltage and note, the differential voltmeter indication should not change more than 100μV.

4-87. AC Rejection

a. Depress the 10 range, VDC, and FILT buttons.

b. Apply a 3V rms ±1%, 60 Hz signal to the INPUT terminals of the 8375A.

c. Adjust the SAMPLE RATE control for a display update about twice a second.

d. The Model 8375A readout should be less than 20 digits.

4-88. OHMS CONVERTER CHECKS

a. Depress the 1000 range, KΩ, and FILT buttons on the 8375A.

b. Place a 1 meg ±0.1% resistor across the INPUT terminals and readout 1000.00 ±.10.

FAULT ANALYSIS

If the readout is bad, check the reference voltage, R17, R18, R19, and R29, or relay K1.

c. Depress the 100 range button.

d. Place a 100k ±.01% resistor across INPUT terminals and readout 100.000 ±.010.

FAULT ANALYSIS

If the readout in step d. is bad, check resistors R21 and R22, or relay K2.

e. Depress the Ω and 1000 range buttons.

f. Measure a 1000 ±.01% resistor using the four-terminal measurement technique (See Figure 4-8).

g. The display should indicate 1000.00 ±.10.

FAULT ANALYSIS

If the readout is incorrect, the resistor network R10, R11, R12, the regulated supply, or K2 may be faulty.

h. Depress the 100 range button.

i. Using the modified four-terminal technique measure a 100 ±.01% resistor.

j. The display should indicate 100.000 ±.010.

FAULT ANALYSIS

If the readout is bad, relay K1, resistors R13, R14, R15, and R16, or the regulated supply may be faulty.

4-89. TRUE RMS CONVERTER CHECKS

a. Depress the VAC and any range button.

b. Connect a DC voltmeter between TP4 and common (shield).

c. Short the HI to LO INPUT terminals together. The DC voltmeter should indicate 0.0 VDC ±0.1 volts.

FAULT ANALYSIS

If the indication is incorrect, go to step e.

d. Remove the input terminal short and apply a full range voltage (for the range selected in step a.) at 500 Hz. The dc voltmeter should indicate 10 VDC ±0.5 volts.

FAULT ANALYSIS

If the indication is incorrect, go to step i.

e. Remove any INPUT voltage or short. Short TP1 to common (shield).

FAULT ANALYSIS

If dc voltmeter indication is within 100 millivolts of zero, go to step i.

f. Short TP1 and TP2 to TP5.

g. Connect the dc voltmeter high lead to TP4. The DC voltmeter should indicate within 100 microvolts of zero and be adjustable using R66 (Integrator Amplifier Zero Adjust).

FAULT ANALYSIS

If the indication is incorrect, troubleshoot the Integrator Amplifier circuit.

h. Remove short on TP2 (maintain short between TP1 and TP5) and connect the high lead of the dc voltmeter to TP2. The voltmeter should indicate 0.0 VDC ±0.2 volts and be adjustable using R55 (Square Root Amplifier Zero Adjust).

FAULT ANALYSIS

If the indication is incorrect, troubleshoot the Square Root Amplifier circuit.

i. Remove any input voltage and disconnect the dc voltmeter and all shorts.

j. Connect a dc coupled scope, using a low capacitance probe, between the threaded body of C11 (10V 50 kHz adjust) and common.

k. With no input voltage applied to the 8375A, the scope should indicate zero volts. With a full range voltage at 500 Hz applied, the scope should indicate a clean sinewave of 2.8 volts peak-to-peak.

FAULT ANALYSIS

If the scope indication is incorrect, troubleshoot the Range Amplifier circuit.

l. Move the scope probe to the cathode of CR16 or anode of CR14.

m. With no input voltage applied, the scope should indicate 0.0 VDC ±0.1 volts. With a full range voltage at 500 Hz applied, the scope should indicate a clean halfwave rectified signal of 1.4 volts peak.

FAULT ANALYSIS

If the scope indication is incorrect, troubleshoot the Balance Amplifier circuit.

n. Move the scope probe to TP1.

o. With no input voltage applied, the scope should indicate 0.0 VDC ±0.1 volts. With full range voltage at 500 Hz applied, the scope should indicate approximately −1.2 volts dc with a clean ac "scallop" superimposed.

FAULT ANALYSIS

If the scope indication is incorrect, troubleshoot Squaring Amplifier.

4-90. Refer to Figure 4-13 for locations of adjustments and test points.

4-90. PRE-CALIBRATION ADJUSTMENTS

4-91. Three adjustments within the RMS Converter are not readjusted during routine calibration. These adjustments are the Square Root Zero, Integrator Zero, and Crest Factor. It is recommended that these three adjustments be attempted only if previously moved or if components are replaced within the converter. Procedure for performing these adjustments is as follows:

a. With power off, extend the RMS Converter from the 8375A mainframe and remove shield from converter. Turn the power on and allow the instrument 10 minutes to stabilize.

b. Short the INPUT terminals. Short TP1 and TP2 to common (shield). Connect the dc voltmeter (Table 6-1) between TP4 (+) and TP5 (−).

c. Adjust R66, Integrator Zero Adjust, for 0 volts ±100 microvolts.

d. Remove the short from TP2 and connect the dc voltmeter (+) lead to TP2.

e. Adjust R55, Square Root Zero, for 0 volts ±200 millivolts.

f. Remove the short from TP1 and disconnect the dc voltmeter.

g. Complete the RMS Converter Adjustments in paragraphs 4-51 through 4-55.

h. Connect equipment as diagramed in Figure 4-12. Set the RMS Converter switch S1 to ac coupling and depress the autorange switch on the front panel.

NOTE!

The following adjustment procedure is for crest factor. Crest factor (cf) is the relationship between the peak and rms value, such that $cf = V_{Peak}/V_{RMS}$.

i. Adjust the generator repetition rate for 100 pulses per second (10 msec) and the pulse width for a maximum indication on Model 931. (This will be a symmetrical waveform.)

j. Adjust the generator negative output amplitude control for a 1 volt rms indication on 931. This establishes a waveform with a crest factor of 1. Note the 8375A front panel voltage reading.

k. Adjust the generator amplitude control for a 4 volts peak-to-peak indication on scope, and the pulse width control for 1 volt RMS indication on Model 931. This establishes a waveform with a crest factor of 4.

l. Adjust R38 (Crest Factor Adjust) for front panel indication noted in step j.

m. Repeat steps i through l until the difference between readings for crest factors of 1 and 4 is less than 10 digits.

n. Check the positive polarity pulse with a crest factor of 4 by connecting the equipment to the pulse generator positive output and making the adjustments described in step k.

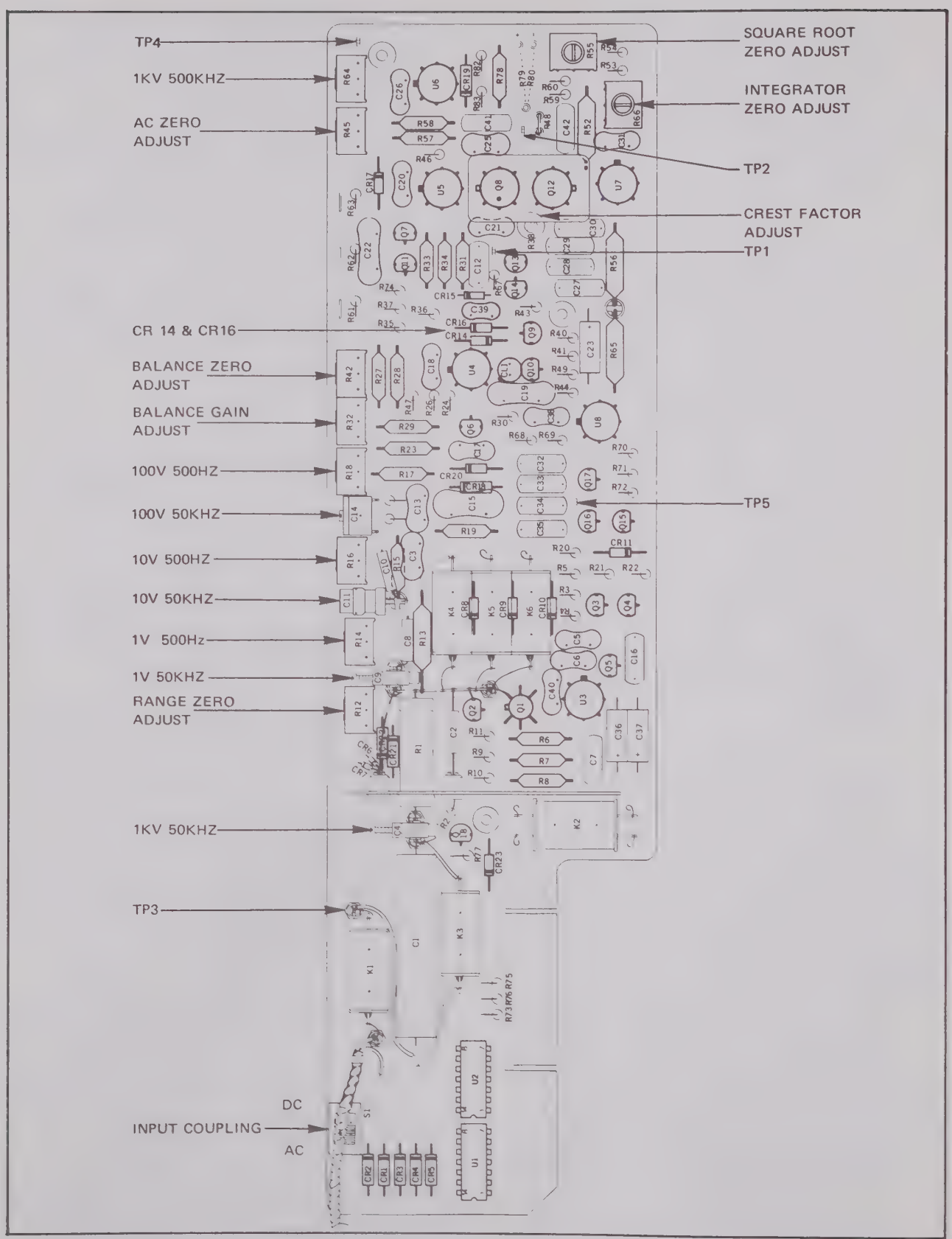


Figure 4-12. RMS CONVERTER ADJUSTMENTS AND TEST POINTS

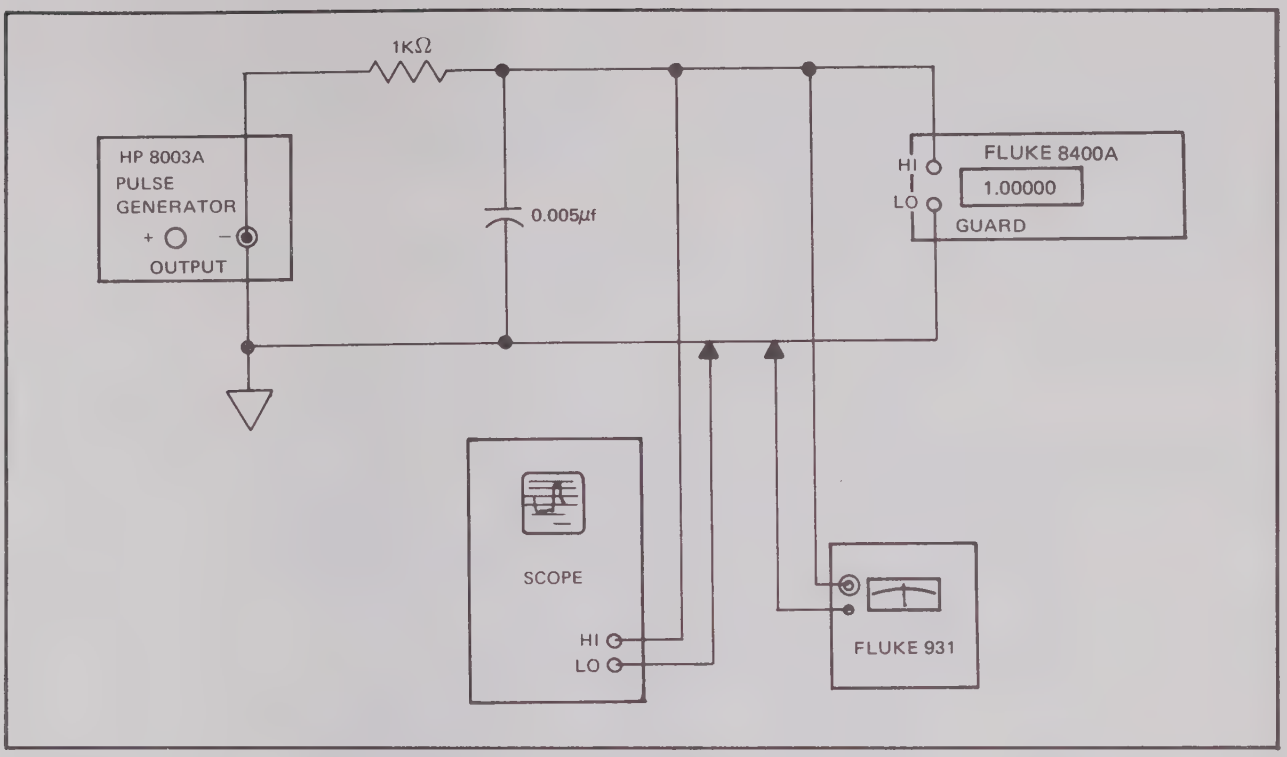


Figure 4-13. EQUIPMENT CONNECTIONS FOR CREST FACTOR ADJUST

o. The 8375A indication should be within 30 digits of the finalized value noted in step j.

p. Turn the power off. Disconnect all test equipment from the 8375A. Re-install the shield on the RMS Converter and install the converter in the mainframe. Install the top guard and dust cover. Turn on the instrument and allow it to "warm-up" for one hour before performing, Calibration Adjustment/Check, paragraph 4-56.

4-92. Digital Section

4-93. The digital section maybe divided into a number of somewhat independent sections for trouble analysis. These digital sections and their locations are as follows:

LOCATION	DIGITAL SECTIONS
A14 – Display	Range Counter
	Sample Command Oscillator
	Readout Tubes and Controls
A9 – A-to-D Converter	A/D Amplifier
	Sample and Hold
	Analog Comparator
	Ladder (Primary and Secondary)
	Display Storage
A8 – Logic	Master Clock
	CCO
	Analog Cycle Control
	Display Storage Control
	6-Sate Shift Register
	16-State Binary Counter

4-94. Generally troubleshooting the digital section is more difficult than the analog section; therefore, troubleshooting guides (Figure 4-13 and 4-14) are important aids for localizing troubles to sections.

NOTE!

The storage cycle can be bypassed if there is a suspicion that the storage circuitry is faulty, (a FAULTY storage cycle is usually seen as flashing digits) by jumpering A1TP5 (+5V) to A14TP2 (M), the Model 8375A is placed into a continuous measurement mode.

4-95. Figure 4-15 through 4-18 are idealized waveforms from significant locations showing relationship of each waveform to the others and to the measure period. Analysis of these waveforms and a comparison to waveforms present at the same points will assist in localizing troubles. All waveforms are as shown when Model 8375A is placed in the continuous measurement condition.

FAULT ANALYSIS

If, after placing the Model 8375A into the continuous measurement condition, the readout is correct, the fault lies in the storage circuitry. If readout is still incorrect the fault lies elsewhere.

4-96. Figure 4-19 through 4-21 show waveforms that are present at A9TP2 with Model 8375A in continuous measurement condition. Analysis of these waveforms to those present under trouble conditions will assist in troubleshooting the digital section.

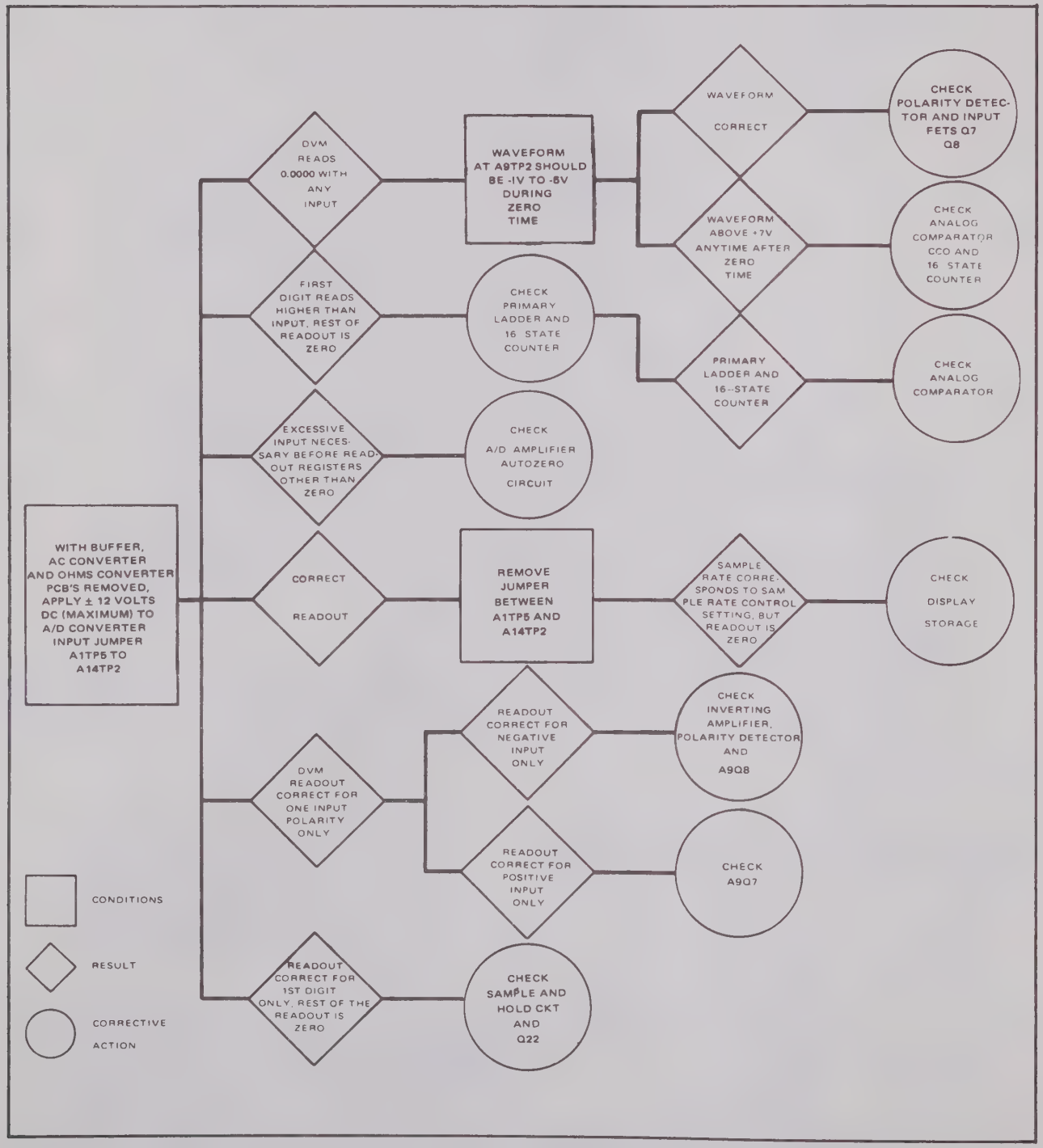

WITH BUFFER, AC CONVERTER AND OHMS CONVERTER PCB'S REMOVED, APPLY ± 12 VOLTS DC (MAXIMUM) TO A/D CONVERTER INPUT JUMPER A1TP5 TO A14TP2
CORRECT READOUT
DVM READS 0.0000 WITH ANY INPUT
WAVEFORM AT A9TP2 SHOULD BE -1V TO -5V DURING ZERO TIME
WAVEFORM CORRECT
CHECK POLARITY DETECTOR AND INPUT FETS Q7 Q8
WAVEFORM ABOVE +7V ANYTIME AFTER ZERO TIME
CHECK ANALOG COMPARATOR CCO AND 16 STATE COUNTER
FIRST DIGIT READS HIGHER THAN INPUT, REST OF READOUT IS ZERO
CHECK PRIMARY LADDER AND 16 STATE COUNTER
PRIMARY LADDER AND 16-STATE COUNTER
CHECK ANALOG COMPARATOR
EXCESSIVE INPUT NECESSARY BEFORE READOUT REGISTERS OTHER THAN ZERO
CHECK A/D AMPLIFIER AUTOZERO CIRCUIT
REMOVE JUMPER BETWEEN A1TP5 AND A14TP2
SAMPLE RATE CORRESPONDS TO SAMPLE RATE CONTROL SETTING, BUT READOUT IS ZERO
CHECK DISPLAY STORAGE
DVM READOUT CORRECT FOR ONE INPUT POLARITY ONLY
READOUT CORRECT FOR NEGATIVE INPUT ONLY
CHECK INVERTING AMPLIFIER, POLARITY DETECTOR AND A9Q8
READOUT CORRECT FOR POSITIVE INPUT ONLY
CHECK A9Q7
READOUT CORRECT FOR 1ST DIGIT ONLY, REST OF THE READOUT IS ZERO
CHECK SAMPLE AND HOLD CKT AND Q22
CONDITIONS
RESULT
CORRECTIVE ACTION

Figure 4-14. TROUBLESHOOTING DVM DIGITAL SECTION

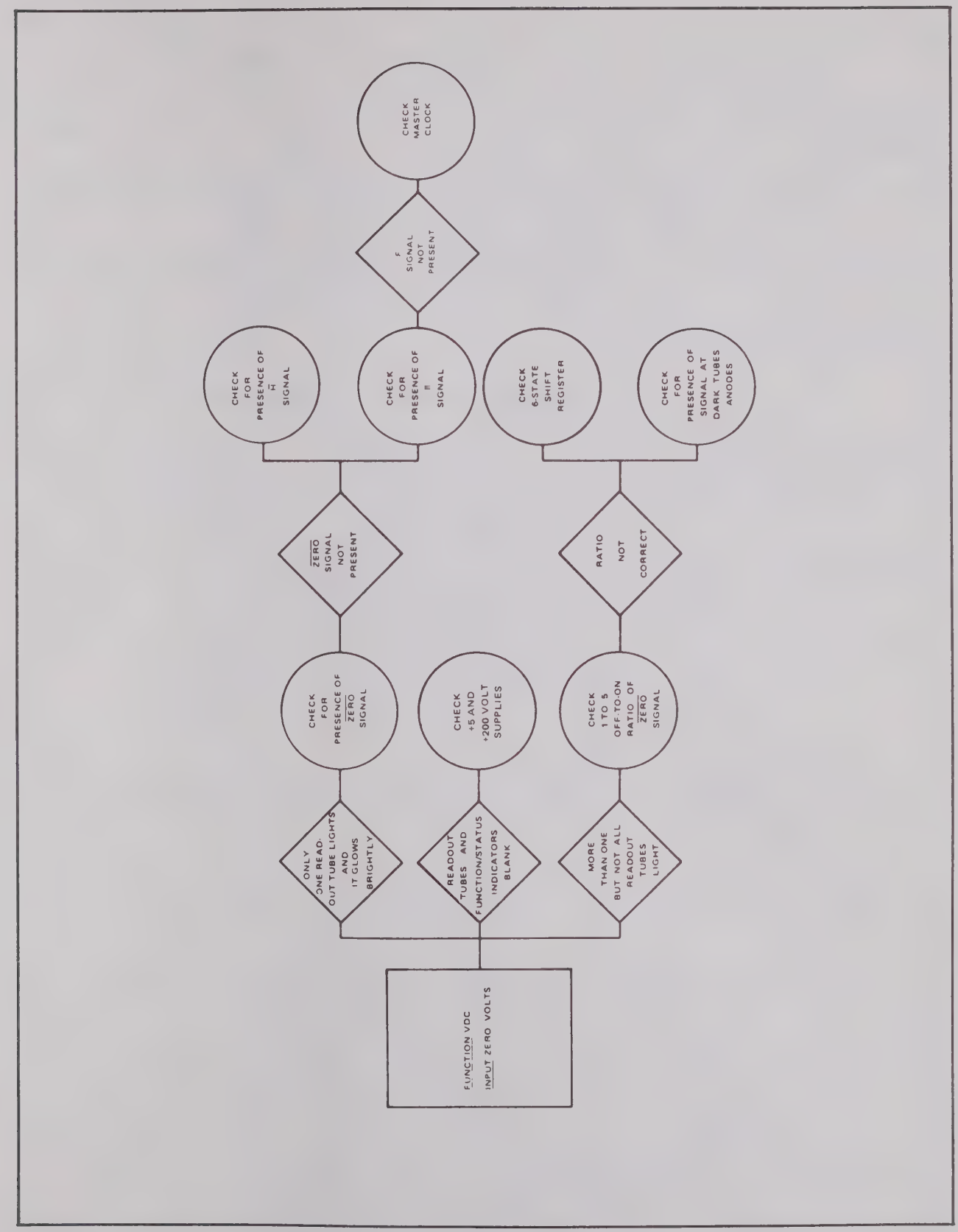

CHECK MASTER CLOCK
F SIGNAL NOT PRESENT
CHECK FOR PRESENCE OF H SIGNAL
CHECK FOR PRESENCE OF F SIGNAL
CHECK 6-STATE SHIFT REGISTER
CHECK FOR PRESENCE OF SIGNAL AT DARK TUBES ANODES
ZERO SIGNAL NOT PRESENT
RATIO NOT CORRECT
CHECK FOR PRESENCE OF ZERO SIGNAL
CHECK +5 AND +200 VOLT SUPPLIES
CHECK 1 TO 5 OFF-TO-ON RATIO OF ZERO SIGNAL
ONLY ONE READ-OUT TUBE LIGHTS AND IT GLOWS BRIGHTLY
READOUT TUBES AND FUNCTION/STATUS INDICATORS BLANK
MORE THAN ONE BUT NOT ALL READOUT TUBES LIGHT
FUNCTION VDC
INPUT ZERO VOLTS

Figure 4-15. TROUBLESHOOTING DVM DISPLAY

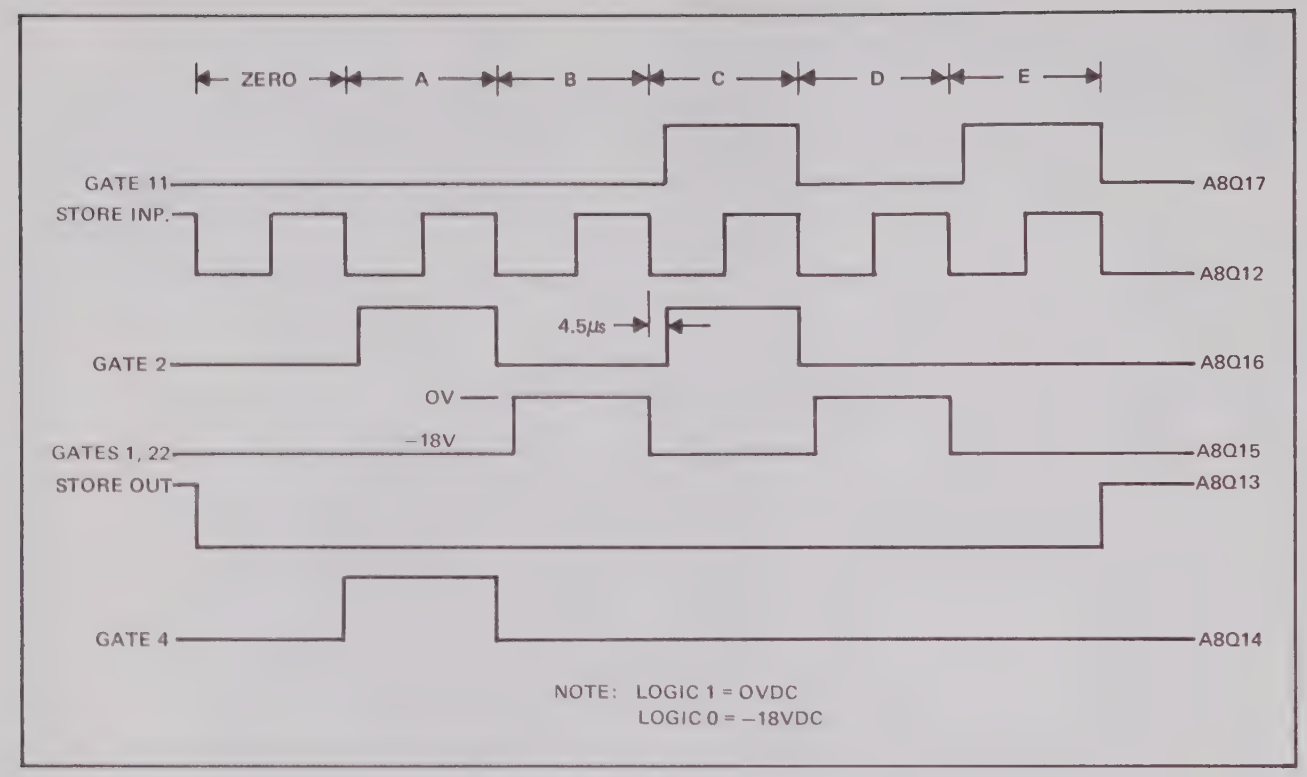


Figure 4-16. A/D CONVERTER CONTROLS

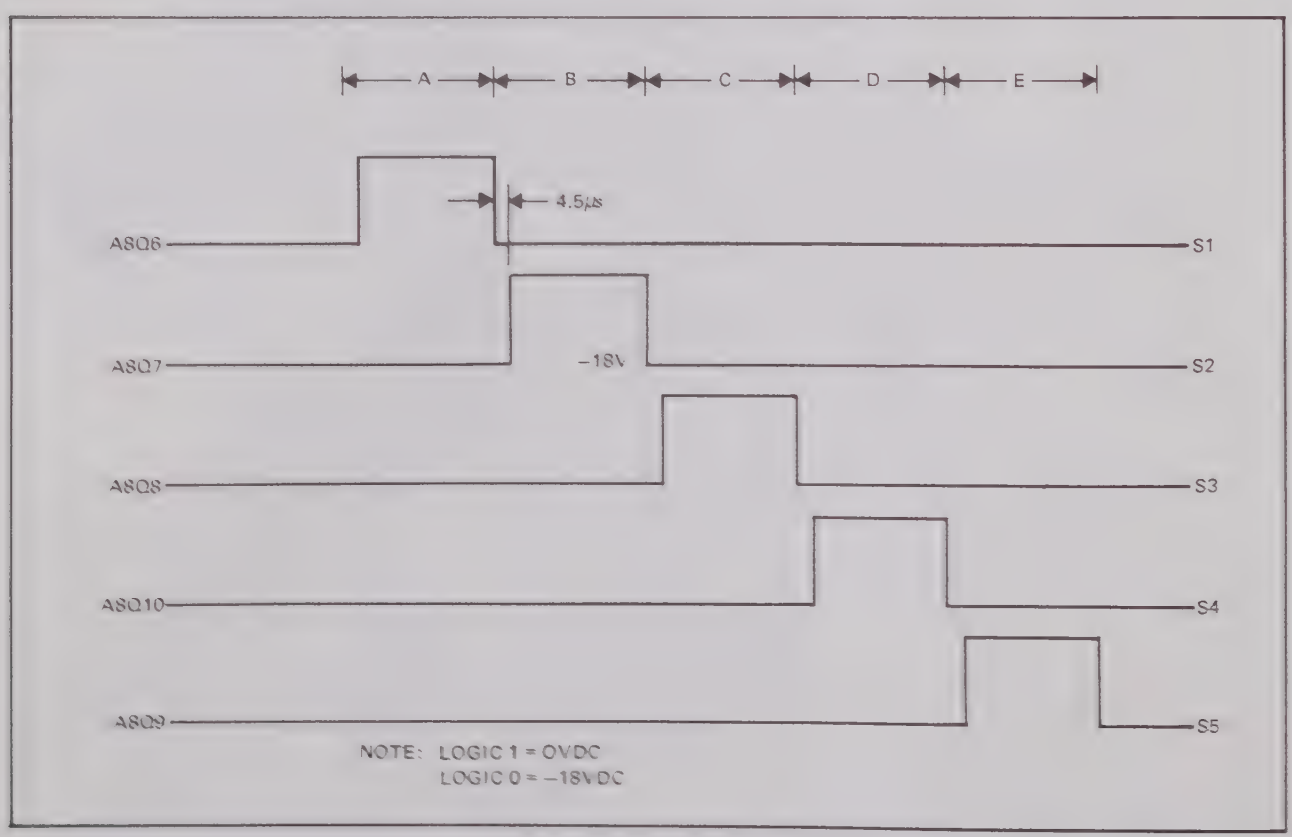
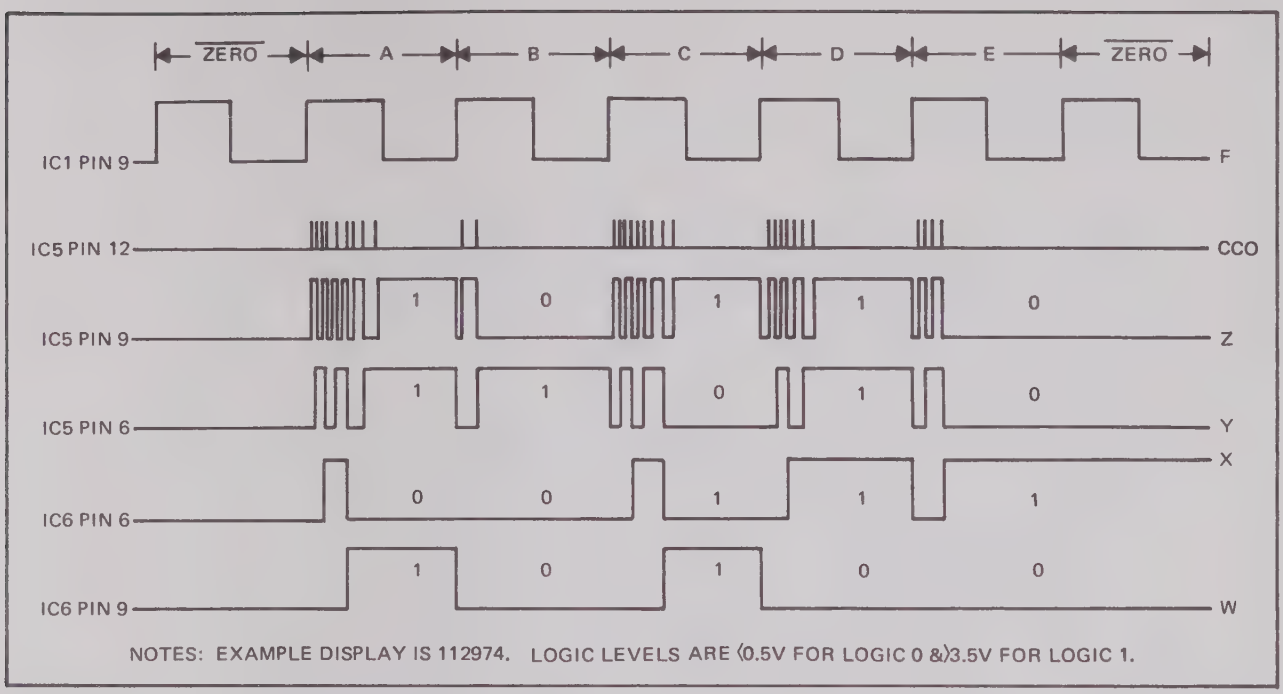
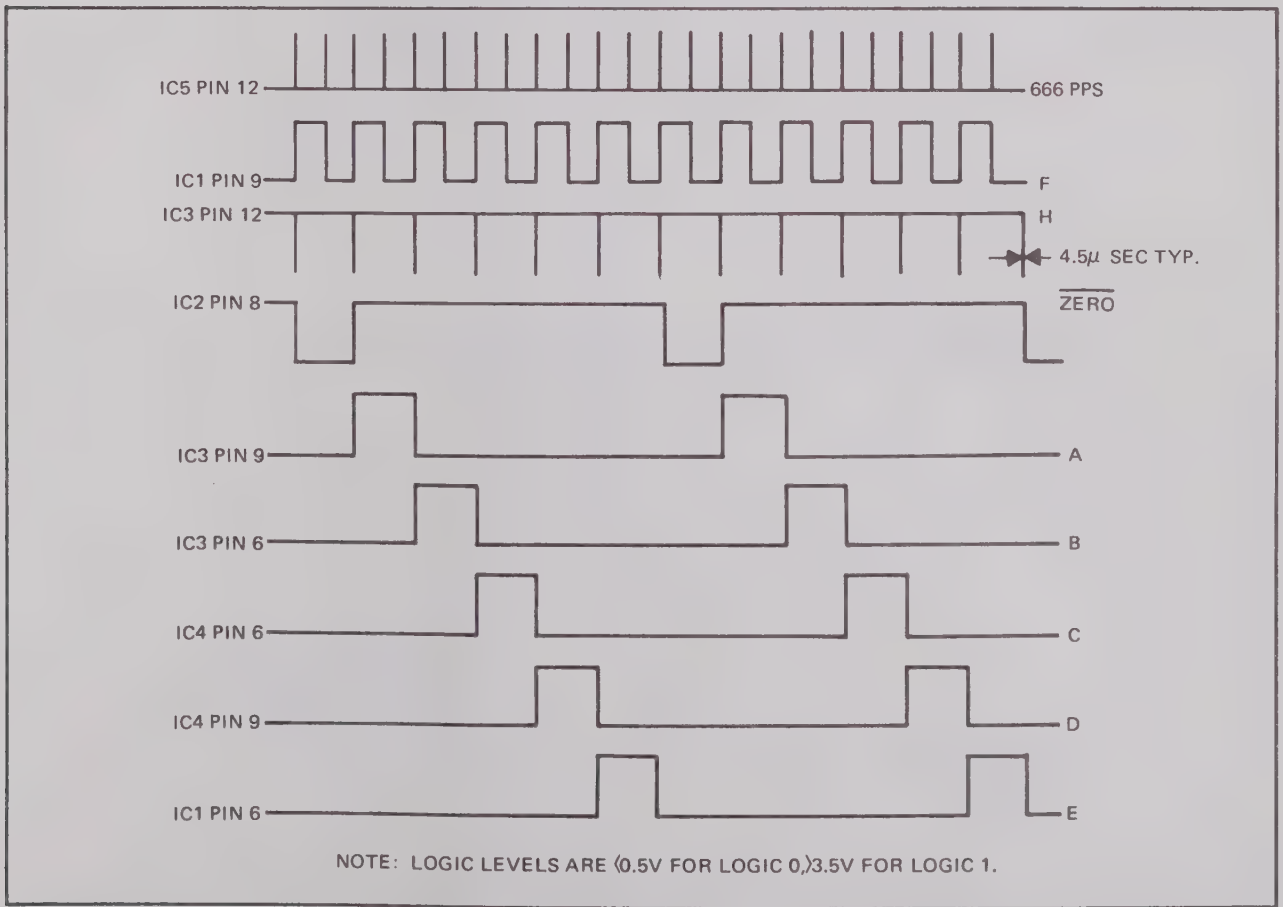


Figure 4-17. ANALOG STORAGE CONTROL



NOTES: EXAMPLE DISPLAY IS 112974. LOGIC LEVELS ARE ⟨0.5V FOR LOGIC 0 &⟩3.5V FOR LOGIC 1.

Figure 4-18. COUNTER OPERATION



NOTE: LOGIC LEVELS ARE ⟨0.5V FOR LOGIC 0,⟩3.5V FOR LOGIC 1.

Figure 4-19. SHIFT REGISTER OPERATION

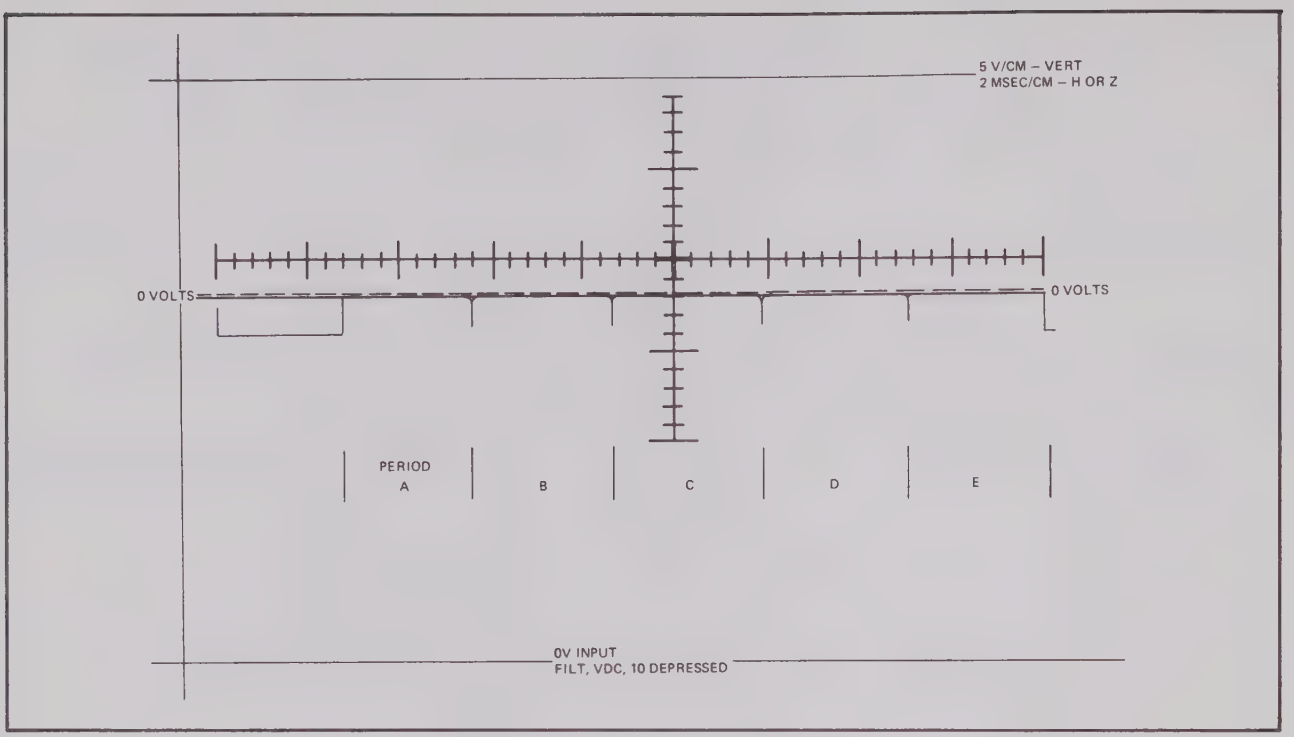


Figure 4-20. A9TP2 MEASUREMENT

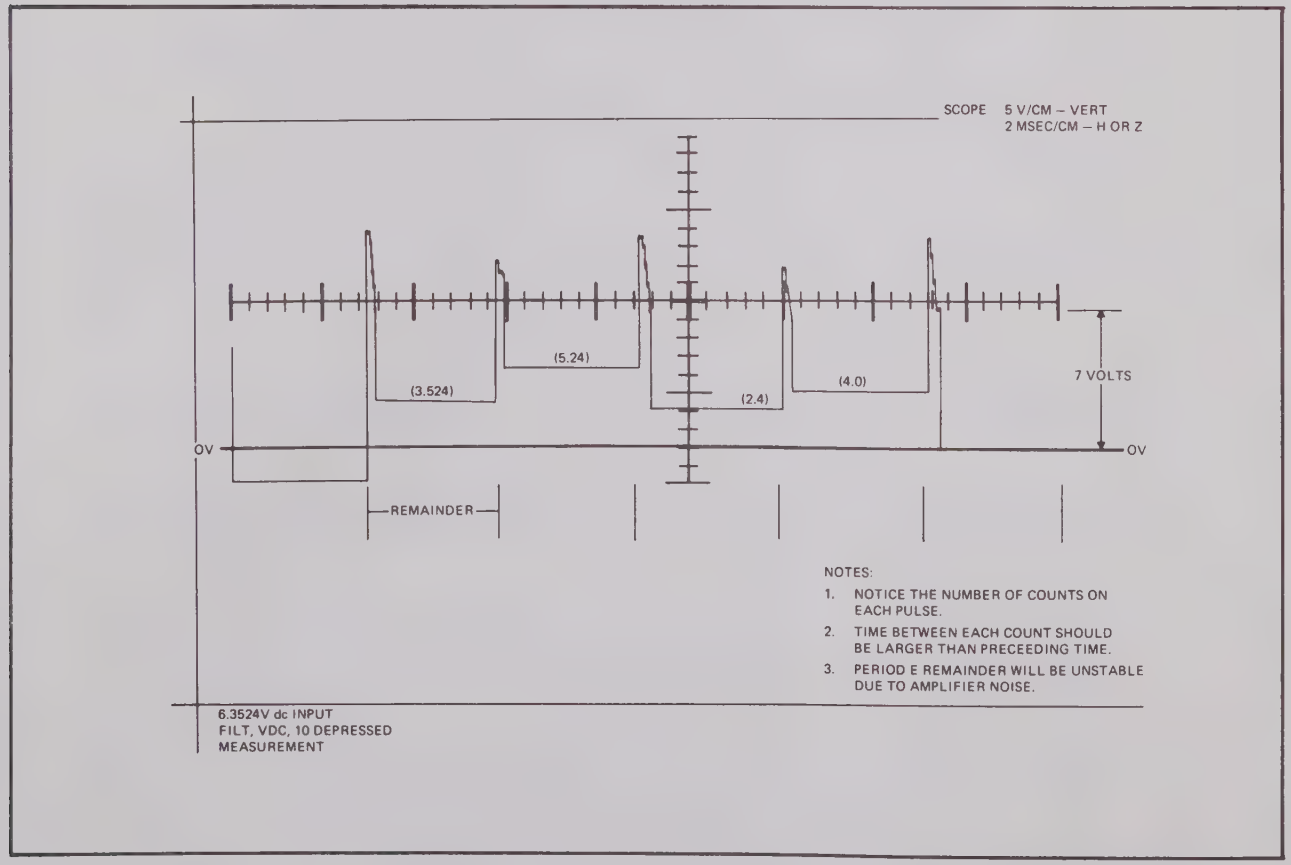


Figure 4-21. A9TP2

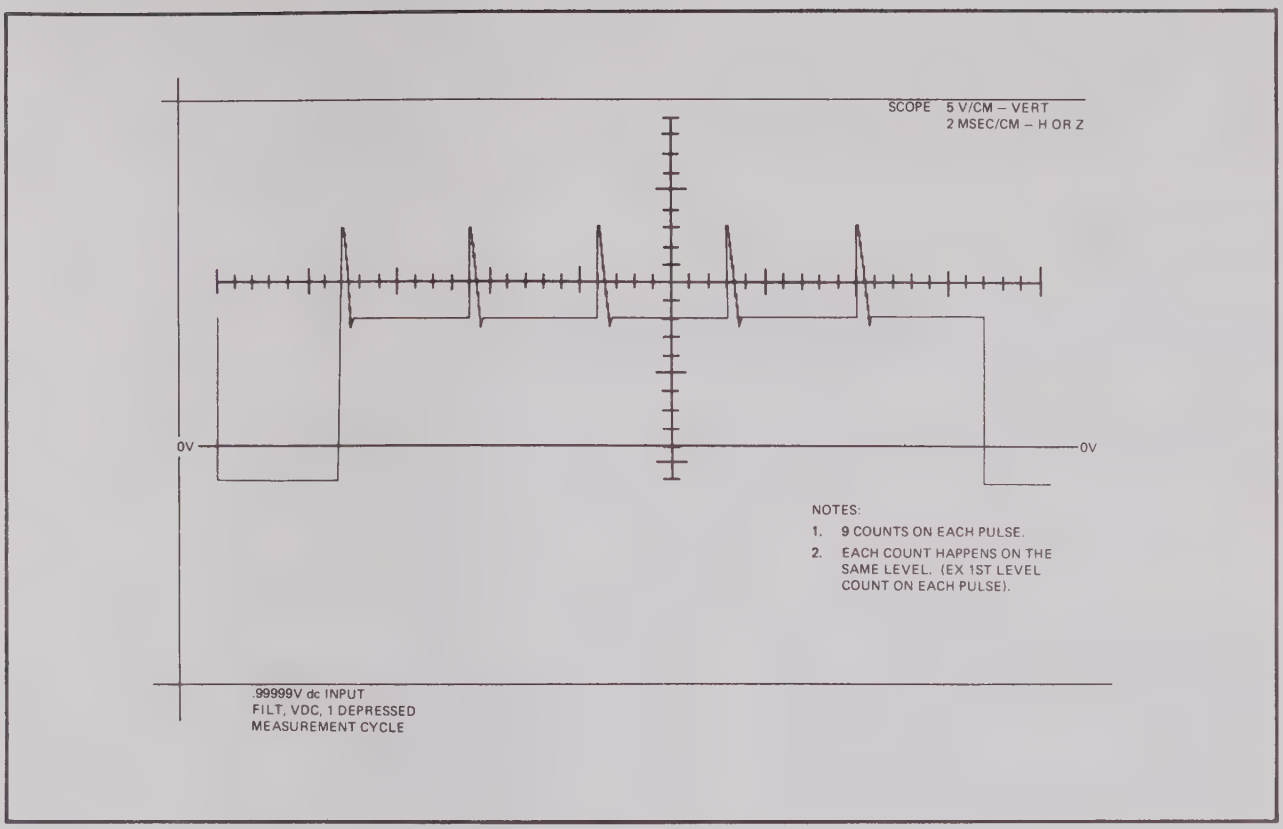

SCOPE 5 V/CM – VERT
2 MSEC/CM – H OR Z
0V
0V
NOTES:
1. 9 COUNTS ON EACH PULSE.
2. EACH COUNT HAPPENS ON THE SAME LEVEL. (EX 1ST LEVEL COUNT ON EACH PULSE).
.99999V dc INPUT
FILT, VDC, 1 DEPRESSED
MEASUREMENT CYCLE

Figure 4-22. A9TP2

Section 5
List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown list of the instrument and a Cross Reference List of FLUKE stock numbers to original MANUFACTURERS' part numbers. It also lists recommended spare parts and contains part ordering information. The starting page number of each major listing is given in the Table of Contents.

5-3. The parts list shows the location of all assemblies and the replaceable components. Major assemblies are identified by a designation beginning with the letter A followed by a number (e.g., A1 etc). Subassemblies are identified in the same manner; however, the parent assembly designator precedes this designator (e.g., A1A1 etc.). Electrical components are identified by their schematic diagram designator and listed hardware parts are identified by the FLUKE stock number. All listed components are described, and the FLUKE stock number is given. The original MANUFACTURER'S part number for each listed item is given in the Cross Reference List at the rear of this section.

5-4. PARTS LIST COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, refer to Appendix B located at the rear of the manual.

c. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives. In the case where a flag note is used, special ordering is required. Flag note explanations are located as close as possible to the flag note.

d. The TOT QTY column lists the total quantity of the item used in each particular assembly. This quantity reflects only the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF.

e. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In

the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part.

5-5. MANUFACTURERS' CROSS REFERENCE LIST COLUMN DESCRIPTIONS

a. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the FLUKE STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

b. The Federal Supply Code for the item manufacturer is listed in the MFG column. An abbreviated list of Federal Supply Codes is included in Appendix A.

c. The part number which uniquely identifies the item to the original manufacturer is listed in the MFG PART NO. column. If a component must be ordered by description, the type number is listed.

5-6. HOW TO OBTAIN PARTS

5-7. Standard components have been used whenever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE stock number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-8. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co., Inc. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 215897, Transistor, 2N4126 A2A1Q1 & Q2 for 645A, S/N 123.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument is helpful.

MODEL 8375A, FINAL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	MODEL 8375A, DIGITAL MULTIMETER **See Figure 5-1**	8375A			
A1	Power Supply PCB Assembly	288159	1		
A2	Range Delay PCB Assembly	288209	1		
A3	DC External Reference PCB Assembly (–05 option, not supplied as part of basic instrument)	1			
A5	Remote Control PCB Assembly (–04 option, not supplied as part of basic instrument)	1			
A6	Data Output No. 2 PCB Assembly (–03 option, not supplied as part of basic instrument)	1			
A7	Data Output No. 1 PCB Assembly (–03 option, not supplied as part of basic instrument)	1			
A8	Logic PCB Assembly (see note 2 below)	2			
A9	A/D Converter PCB Assembly (see note 2 below)	2			
A10	Active Filter PCB Assembly	290346	1		
A11	Buffer PCB Assembly	288191	1		
A12	Ohms Converter PCB Assembly	288217	1		
A13	RMS Converter PCB Assembly	339309	1		
	Front Panel Assembly	356139	1		
	Rear Panel Assembly	301374	1		
	Bottom Cover, outer	298554	1		
	Corner Handle, front	295659	2		
R1,R2	Res, ww, 50K ±0.25%	307298	2		
S1	Switch, Power	291526	1		
	Pushbutton, Green	268862	1		
	Cable, Power	361154	1		
	Foot, Bail Stand	292870	4		
	Test Instruction Plate	362806	1		
	Guard Cover	356253	1		
	Top Cover, outer	311746	1		
	Decal, handle trim	295485	2		
	1 Order by Model and Option No.				
	2 A8 and A9 must be ordered as a set using Stock Number 303461				

FRONT PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	FRONT PANEL ASSEMBLY **See Figure 5-1**	356139			
A14	Display Assembly	356568	1		
	Lens, display	356113	1		
S3	Switch, Lever	357590	1		
R4	Res, metal film, 100 ± 0.1%, 1/8w	357400	1		
R3	Res, comp, 10M ± 10%, 1/2w	108142	1		
J26,J27	Binding Post, Red	275552	2		
J25,J28	Binding Post, Black	275560	2		
J32	Binding Post, Blue	275578	1		
	Lens, decimal lamp	194597	1		

REAR PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	REAR PANEL ASSEMBLY **See Figure 5-1**	301374			
	Line Cord, ac	301424	1		
XF1	Fuse Holder	295741	1		
T1	Power Transformer	365171	1		
	Power Receptacle, ac	284166	1		
F1	Fuse, fast-blo, type AGC	153858	1		
	Rear Panel (includes line voltage switch S2, part no. 226274)	297648	1		

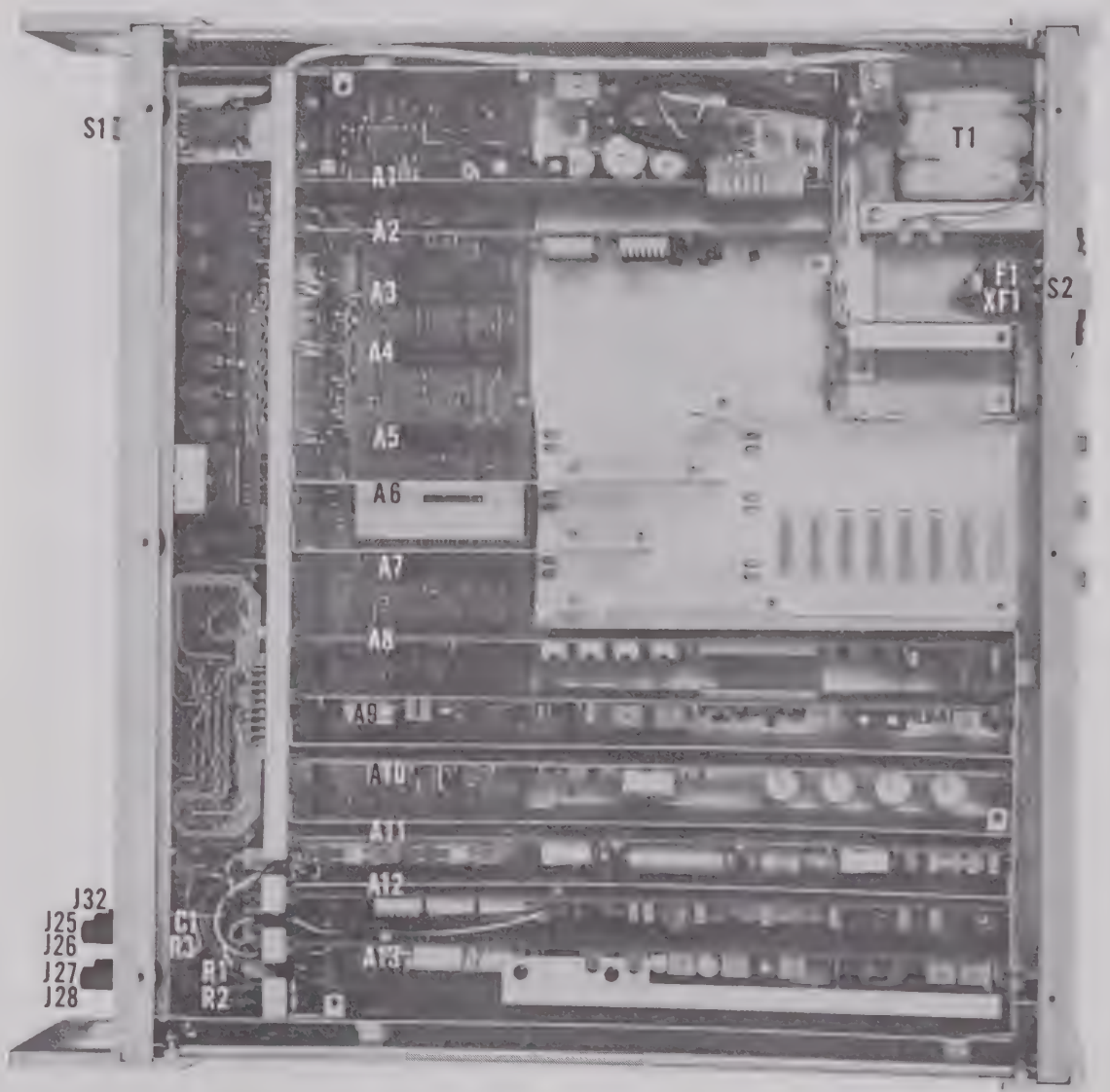


Figure 5-1. MODEL 8375A DIGITAL MULTIMETER

A1, POWER SUPPLY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	POWER SUPPLY PCB ASSEMBLY Figure 5-2	288159	REF		
C1	Cap, elect, 8 uf +50/−10%, 350V	275792	1		
C2, C5	Cap, elect, 250 uf +50/−10%, 40V	178616	2		
C3, C7	Cap, mica, 33 pf ±5%, 500V	160317	2		
C4, C6	Cap, elect, 50 uf +50/−10%, 25V	168823	2		
C8	Cap, elect, 7100 uf +75/−10%, 10V	295196	1		
CR1 thru CR4	Diode, silicon, 1 amp, 600 piv	112383	4		
CR5 thru CR8, CR10 thru CR13	Diode, silicon, 1 amp, 100 piv	116111	8		
CR9	Diode, zener, 12V	249052	1		
Q1, Q2	Tstr, silicon, NPN	218511	2		
Q3, Q8	Tstr, silicon, NPN	150359	2		
Q4	Not used				
Q5	Tstr, silicon, PNP	269076	1		
Q6	Tstr, silicon, NPN	288381	1		
Q7	Tstr, silicon, NPN	218396	1		
R1	Res, comp, 510Ω ±5%, 1/2w	108951	1		
R2	Res, comp, 68k ±5%, 1/4w	148171	1		
R3	Res, met flm, 383k ±1%, 1/8w	288498	1		
R4, R15	Res, met flm, 40.2k ±1%, 1/8w	235333	2		
R5, R8	Res, comp, 51Ω ±5%, 1/2w	144717	2		
R6	Res, ww, 7.2k ±0.1%, 1/4w	295121	1		
R7	Not used				
R9	Res, ww, 4.02k ±0.1%, 1/4w	240937	1		
R10, R12	Res, met flm, 10k ±1%, 1/8w	168260	2		
R11	Res, var, cer met, 500Ω ±10%, 1w	291120	1		
R13, R16	Res, comp, 5.6k ±5%, 1/4w	148080	2		
R14	Res, met flm, 9.53k ±1%, 1/8w	288563	1		
R17	Res, comp, 220k ±5%, 1/4w	160937	1		
U1, U2,	IC, operational amplifier	271502	2		

A1, POWER SUPPLY PCB ASSEMBLY

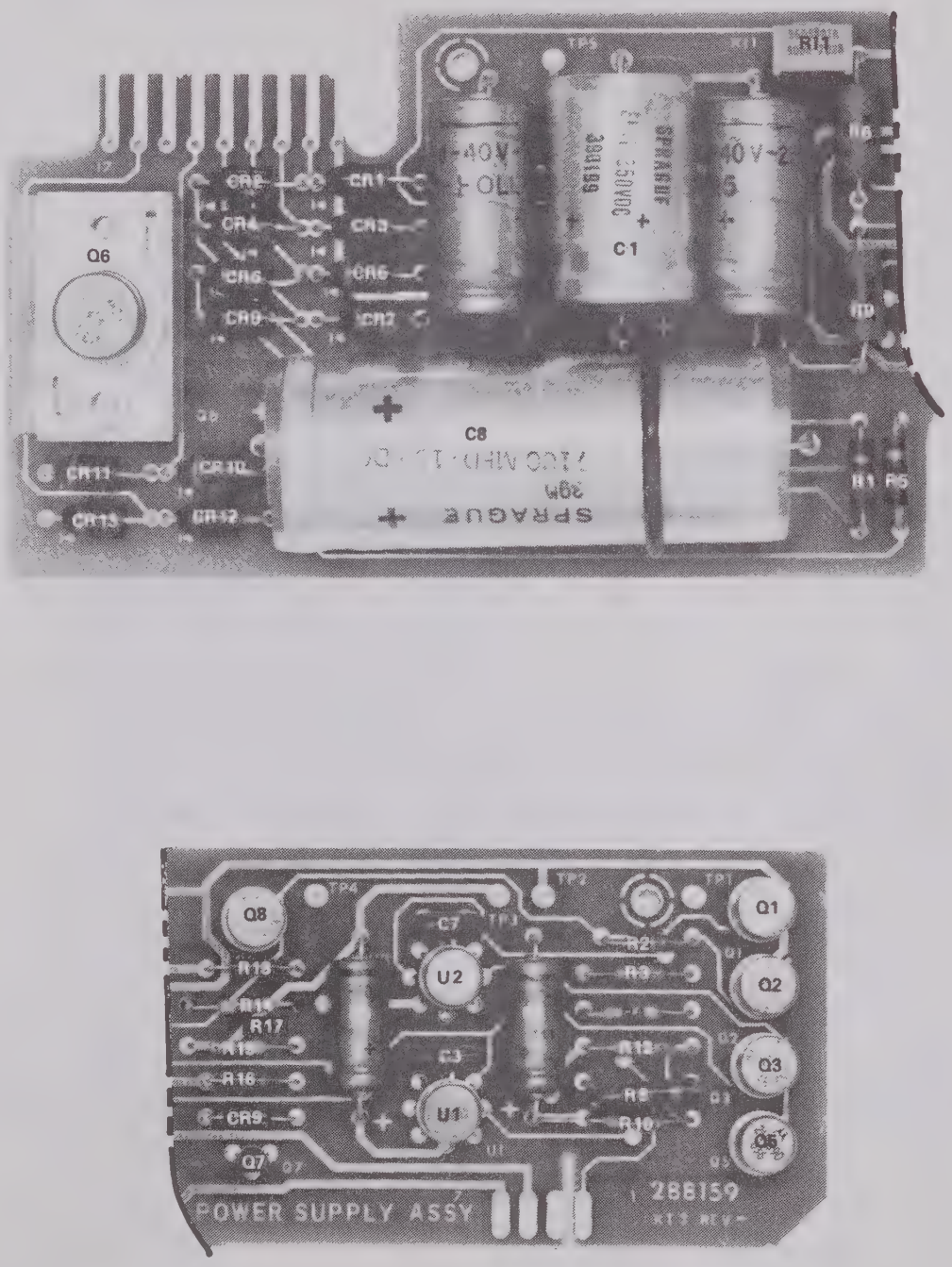


Figure 5-2. POWER SUPPLY PCB ASSEMBLY

A2, RANGE DELAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	RANGE DELAY PCB ASSEMBLY				
A2	**Figure 5-3**	288209	REF		
C1, C3	Cap, cer, 0.025 uf ±20%, 100V	168435	2		
C2, C6	Cap, Ta, 3.3 uf ±5%, 20V	271320	2		
C4	Cap, mica, 0.01 uf ±1%, 300V	152470	1		
C5	Cap, elect, 200 uf +50/−10%, 10V	236935	1		
CR1, CR3, CR9, CR11	Diode, silicon 150 mA	203323	4		
CR2, CR6, CR7, CR8, CR10	Diode, germanium, 80 mA, 100 piv	149187	5		
CR4, CR5	Diode, fast switching germanium, 50 piv	180505	2		
CR12, CR13 CR14, CR15	Diode, germanium, 80 mA, 100 piv	149187	4		
CR16	Diode, silicon, 150 mA	203323	1		
Q1, Q2	Tstr, silicon, NPN	168708	2		
Q3	Tstr, silicon, NPN	218396	1		
Q4	Tstr, silicon, unijunction	268110	1		
Q5	Tstr, silicon, NPN	218396	1		
R1, R6, R15	Res, comp, 220Ω ±5%, 1/4w	147959	3		
R2	Res, comp, 22k ±5%, 1/4w	148130	1		
R3, R7	Res, comp, 4.7k ±5%, 1/4w	148072	2		
R4, R17	Res, comp, 27k ±5%, 1/4w	148148	2		
R5	Res, comp, 51k ±5%, 1/4w	193334	1		
R8	Res, met flm, 27.4k ±1%, 1/8w	241471	1		
R9	Res, met flm, 15.4k ±1%, 1/8w	261651	1		
R10	Res, comp, 47k ±5%, 1/4w	148163	1		
R11	Res, comp, 10k ±5%, 1/4w	148106	1		
R12	Res, met flm, 10k ±1%, 1/8w	168260	1		
R13	Res, met flm, 36.5k ±1%, 1/8w	235309	1		
R14	Res, met flm, 16.9k ±1%, 1/8w	267146	1		
R16	Res, comp, 5.1k ±5%, 1/4w	193342	1		

A2, RANGE DELAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R18	Res, var, cer met, 10k ±10%, 1/2w	285171	1		
R19	Res, comp, 10k ±5%, 1/4w	148106	1		
U1	IC, DTL, Hex Inverter	268367	1		
U2	IC, DTL, Triple 3-Input Nand Gate	266312	1		
U3	IC, DTL, dual 4-Input Nand	268383	1		
	Socket, IC, 14 contact, U1, U2, U3	276527	3		

A2, RANGE DELAY PCB ASSEMBLY

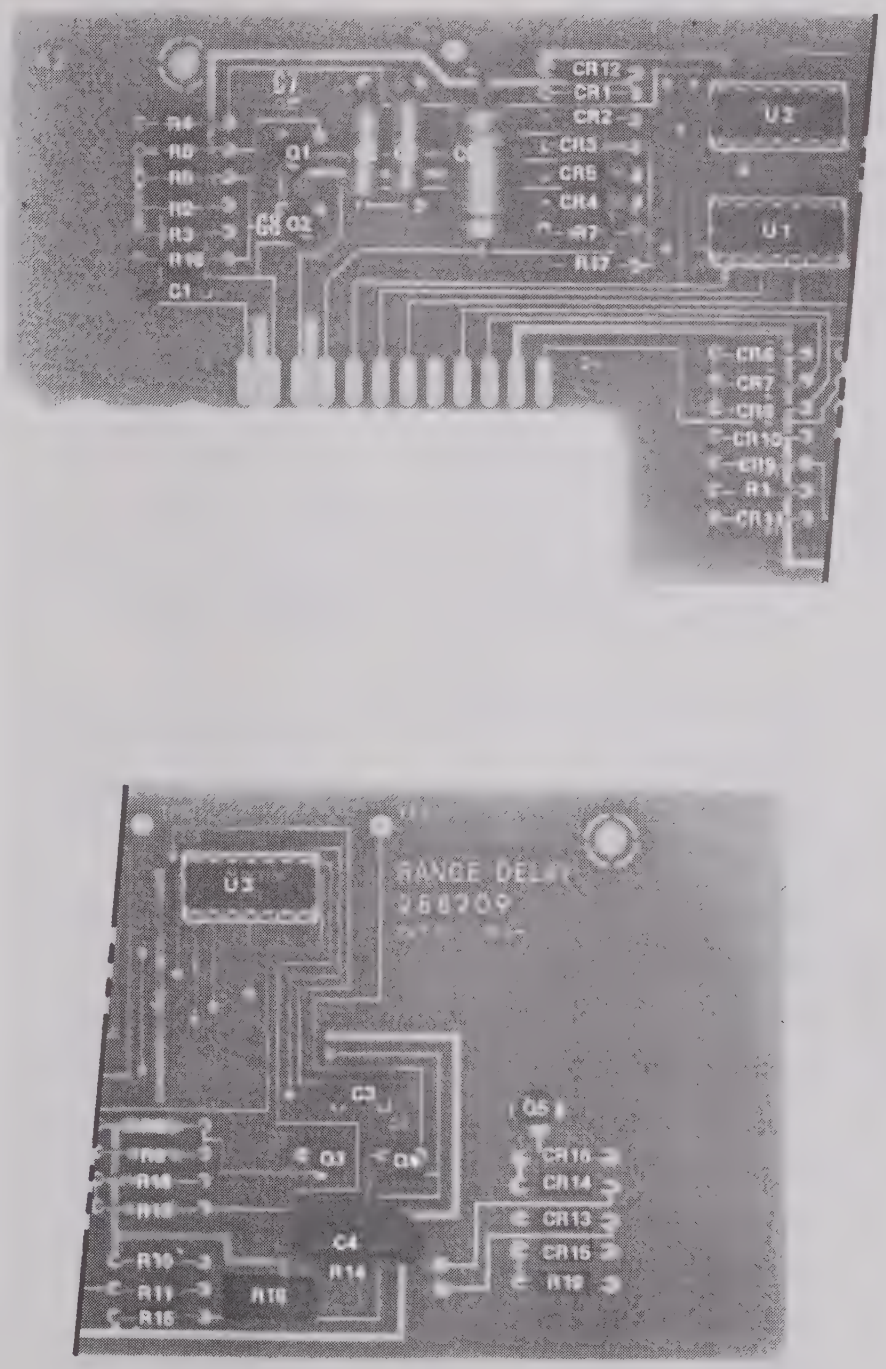


Figure 5-3. RANGE DELAY PCB ASSEMBLY

A8, LOGIC PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A8	**LOGIC PCB ASSEMBLY** **Figure 5-4**	288183	REF		
C1	Cap, mica, 5600 pf ± 2%, 500V	182873	1		
C2	Cap, mica, 1500 pf ± 5%, 500V	148361	1		
C3	Cap, cer, 180 pf ± 10%, 1kV	105890	1		
C4	Cap, mica, 470 pf ± 5%, 500V	148429	1		
C5	Cap, cer 2200 pf ± 10%, 500V	268425	1		
C6	Cap, mica, 33 pf ± 5%, 500V	160317	1		
C7	Cap, mica, 270 pf ± 5%, 500V	148452	1		
CR1,CR2, CR5,CR6, CR7,CR10, CR11	Diode, silicon, 150 mA	203323	7		
CR3	Diode, silicon, 1 amp, 100 piv	116111	1		
CR4,CR8, CR9	Diode, germanium, 80 mA, 100 piv	149187	3		
P23	Connector, PCB to Cable, 34 contact	295337	1		
Q1	Tstr, silicon, unijunction	268110	1		
Q2 thru Q5 Q19 thru Q22 Q24,Q26	Tstr, silicon, NPN	218396	10		
Q6 thru Q17	Tstr, silicon PNP	195974	12		
Q18	Tstr, germanium, PNP	148619	1		
Q23	Tstr, silicon, NPN	168716	1		
Q25	Tstr, silicon, NPN	168708	1		
R1	Res, met flm, 750k ± 1%, 1/2w	155192	1		
R2	Res, met flm, 110k ± 1%, 1/8w	234708	1		
R3	Res, comp, 47Ω ± 5%, 1/4w	147892	1		
R4	Res, met flm, 46.4k ± 1%, 1/8w	188375	1		
R5,R19	Res, comp, 2.7k ± 5%, 1/4w	170720	2		
R6,R21, R28,R29, R31,R32, R33	Res, comp, 1.5k ± 5%, 1/4w	148031	7		
R7	Res, comp, 820Ω ± 5%, 1/4w	148015	1		

A8, LOGIC PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R8,R59 R60	Res, comp, 10k ±5%, 1/4w	148106	3		
R9	Res, comp, 27k ±5%, 1/4w	148148	1		
R10	Res, comp, 1k ±5%, 1/4w	148023	1		
R11,R20, R37	Not Used				
R12,R40	Res, comp, 4.7k ±5%, 1/4w	148072	2		
R13,R25, R26,R27	Res, comp, 8.2k ±5%, 1/4w	160796	4		
R14 thru R16,R18	Res, comp, 51k ±5%, 1/4w	193334	4		
R22,R23	Res, comp, 2.2k ±5%, 1/4w	148049	2		
R24,R64	Res, comp, 1.8k ±5%, 1/4w	175042	2		
R30	Res, comp, 680Ω ±5%, 1/4w	148007	1		
R34,R35, R36,R38, R39	Res, comp, 22k ±5%, 1/4w	148130	5		
R42	Res, comp, 33k ±5%, 1/4w	148155	1		
R43,R66	Res, comp, 47k ±5%, 1/4w	148163	2		
R44,R50, R52	Res, comp, 220k ±5%, 1/4w	160937	3		
R45,R46, R48,R49, R51,R65	Res, comp, 11k ±5%, 1/4w	221580	6		
R47	Res, comp, 39k ±5%, 1/4w	188466	1		
R53	Res, met flm, 182k ± 1%, 1/8w	241091	1		
R54	Res, met flm, 3.74k ±1%, 1/8w	260547	1		
R57	Res, var, cer met, 20Ω ±20%, 1/2w	261180	1		
R58	Res, ww, 14k ±0.1%, 1/4w	275321	1		
R61	Res, comp, 1.2k ±5%, 1/4w	190371	1		
R63	Res, met flm, 3.74k ±1%, 1/8w	272096	1		
U1,U3 thru U6	IC, TTL, dual J-K flip flop	268441	5		
U2	IC, DTL, dual 4-Input Nand	268383	1		

A8, LOGIC PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
U7	IC, TTL, dual 4-Input Expandable Nor Gate	268557	1		
U8	IC, DTL, Quad 2-Input Nand Gate	268375	1		
U9,R55, R56,R62	Matched Reference Amplifier Set	290650	1		
U10	IC, Operational Amplifier	271502	1		
	Socket, IC, 14 contact, U2, U7, U8	276527	3		
	Socket, IC, 16 contact, U1, U3 thru U6	276535	5		

A8, LOGIC PCB ASSEMBLY

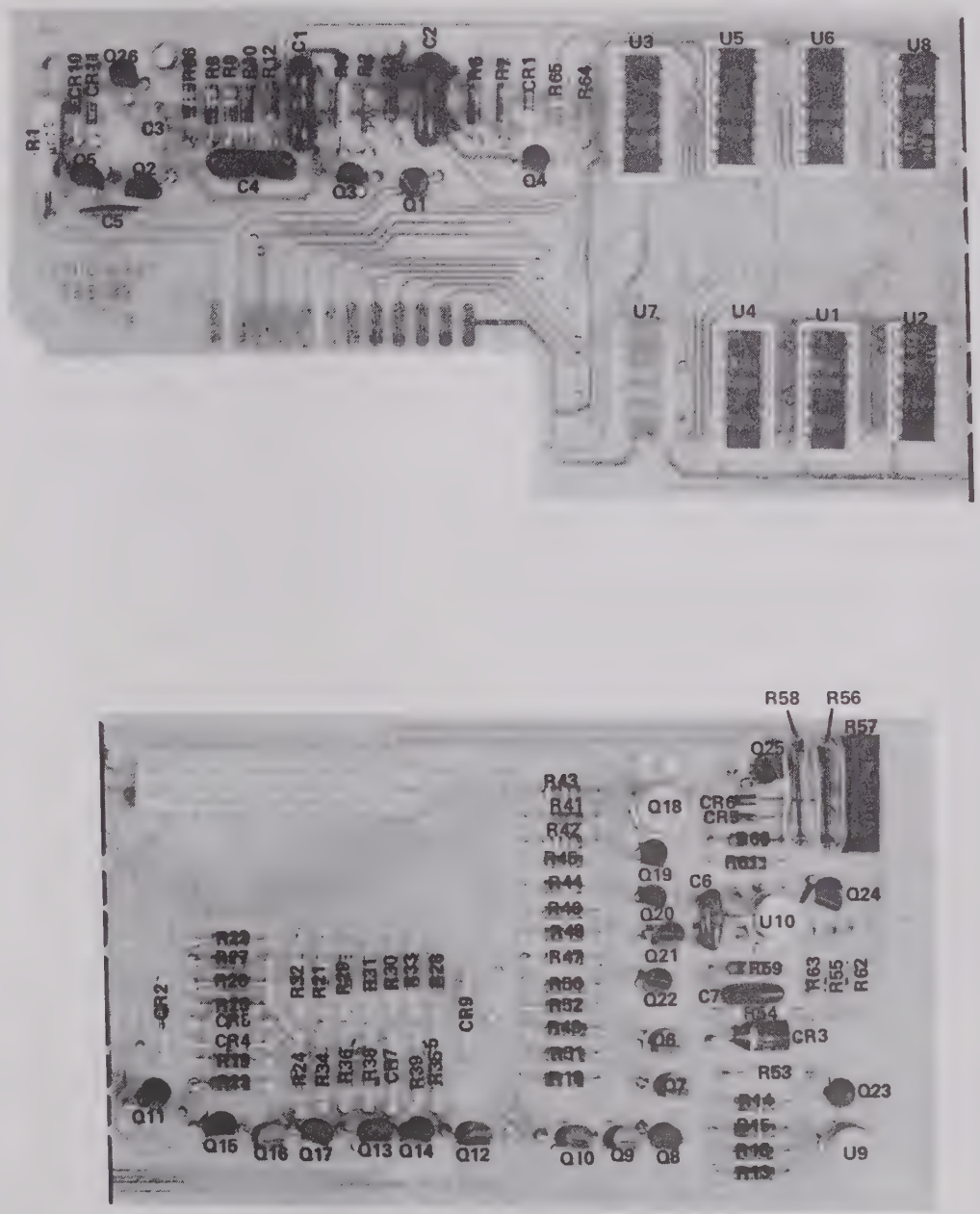


Figure 5-4. LOGIC PCB ASSEMBLY

A9, A/D CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A9	A/D CONVERTER PCB ASSEMBLY Figure 5-5	288175	REF		
C1,C3, C4,C5	Cap, mica, 390 pf ±5%, 500V	148437	4		
C2,C7	Cap, plstc, 0.47μf ± 10%, 250V	184366	2		
C6,C16, C18,C19	Cap, mica, 33 pf ± 5%, 500V	160317	4		
C8	Cap, cer, 15 pf ± 10%, 500V	159947	1		
C9,C10	Cap, plstc, 0.047μf ± 10%, 120V	260562	2		
C11 thru C15	Cap, cer, 0.01μf ± 20%, 100V	149153	5		
C17	Cap, plstc, 0.047μf ± 10%, 250V	162008	1		
C20	Cap, mica, 2 pf ± 10%, 500V	175208	1		
C21	Cap, mica, 1000 pf ± 5%, 500V	148387	1		
CR1,CR2, CR16, CR19	Diode, silicon, 150 mA, 125 piv	272252	4		
CR3,CR4, CR5,CR7, thru CR15	Diode, silicon, 150mA	203323	12		
CR6,CR20	Diode, germanium, 80mA, 100 piv	149187	2		
CR17	Diode silicon, 75mA, 90 piv	260554	1		
CR18	Diode, zener, 6.8V	187195	1		
P24	Connector, PCB to cable, 34 contact	295337	1		
Q1,Q21, Q45	Tstr, silicon, NPN	218396	3		
Q32	Tstr, silicon, PNP	195974	1		
Q3,Q6, Q19,Q22, Q23,Q24	Tstr, FET, N-channel	271924	6		
Q4	Tstr, FET, dual, N-channel	257501	1		
Q5,Q13 thru Q17, Q31,Q36	Tstr, FET, N-channel	288324	7		
Q7,Q8,Q9	Tstr, FET, N-channel, Matched Set (must be replaced as a set)	274795	1		

A9, A/D CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q10,Q11, Q29,Q33, Q34	Tstr, silicon, PNP	288761	5		
Q30	Tstr, silicon, PNP	321398	1		
Q12,Q18, Q25 thru Q28	Tstr, FET, N-channel	261388	6		
Q20	Tstr, FET, dual, N-channel	267963	1		
Q35	Tstr, silicon, NPN, dual, monolithic	295717	1		
Q37,Q39, Q41,Q43	Tstr, germanium, NPN	306126	4		
Q38,Q40, Q42,Q44	Tstr, germanium, PNP	306118	4		
R4	Res, comp, 4.7k ± 5%, 1/4w	148072	1		
R2,R3	Res, comp, 47k ± 5%, 1/4w	148163	2		
R5,R34, R53,R62, R63,R80	Res, comp, 100k ± 5%, 1/4w	148189	6		
R6,R36, R59,R64	Res, comp, 10k ± 5%, 1/4w	148106	4		
R7,R13	Res, ww, 10k, Matched Set	291690	1		
R8,R9,R31	Res, met film, 45.3k ± 1%, 1/8w	234971	3		
R10	Res, met film, 49.9k ± 1%, 1/8w	268821	1		
R11	Res, comp, 68k ± 5%, 1/4w	148171	1		
R12	Res, comp, 220Ω ± 5%, 1/4w	147959	1		
R14,R17 R45	Res, var, cer met, 20Ω ± 20%, 1/2w	261180	3		
R15,R16 R44,R46 R47 R49 R51	Res, ww, 28.578k Res, ww, 50k Res, ww, 100k Res, ww, 200k Res, ww, 199.98k Matched Set	285239	1		
R19,R22	Res, comp, 33.2k .0, –5%, 1/8w	334102	2		
R20,R21	Res, comp, 22k ± 5%, 1/4w	148130	2		
R23,R18	Res, met film, 4.99k 0.1%, 1/8w	334110	2		
R24,R25, R35	Res, comp, 220k ± 5%, 1/4w	160937	3		

A9, A/D CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R26	Res, comp, 82Ω ± 5%, 1/4w	149484	1		
R27	Res, met flm, 21.5k ± 1%, 1/8w	168278	1		
R28,R78	Res, comp, 27k ± 5%, 1/4w	148148	2		
R29	Res, met flm, 22.1k ± 1%, 1/8w	235234	1		
R30	Res, comp, 820k ± 5%, 1/4w	220541	1		
R32,R79	Res, comp, 15k ± 5%, 1/4w	148114	2		
R33	Res, comp, 1k ± 5%, 1/4w	148023	1		
R37	Res, var, cer met, 10k ± 10%, 1w	285171	1		
R38,R39	Res, comp, 6.2M ± 5%, 1/4w	221960	2		
R40,R41	Res, met flm, 750k ± 1%, 1/8w	271361	2		
R42	Res, met flm, 1.5M ± 1%, 1/4w	284976	1		
R43	Res, comp, 3M ± 5%, 1/4w	221952	1		
R48	Res, var, cer met, 50 Ω ± 10%, 1w	285122	1		
R50	Res, var, cer met, 100Ω ± 10%, 1w	285130	1		
R52	Res, comp, (nominally 22Ω ± 5%, 1/4w)	147884	1		
R54	Res, comp, 18k ± 5%, 1/4w	148122	1		
R55	Res, ww, 1.022k ± 0.05%, 1/4w	288654	1		
R56	Res, var, cer met, 20Ω ± 20%, 1w	285114	1		
R57	Res, ww, 5k ± 0.05%, 1/4w	288647	1		
R58	Res, var, cer met, 200Ω ± 20%, 1/2w	284711	1		
R60	Res, comp, 150k ± 5%, 1/4w	182212	1		
R61	Res, var, cer met, 200Ω ± 10%, 1w	285148	1		
R65	Res, comp, 510k ± 5%, 1/4w	275685	1		
R66,R68, R70,R72	Res, met flm, 4.99k ± 1%, 1/8w	168252	4		
R67,R69, R71,R73	Res, met flm, 32.4k ± 1%, 1/8w	182956	4		
R74	Res, met flm, 6.04k ± 1%, 1/8w	285189	1		
R75	Res, met flm, 1k ± 1%, 1/8w	168229	1		
R76	Res, comp, 270k ± 5%, 1/4w	220061	1		
R77	Res, met flm, 16.9Ω ± 1%, 1/8w	281790	1		

A9, A/D CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R81	Res, comp, 4.7M ± 5%, 1/4w	220046	1		
U1 thru U4	IC, operational amplifier	271502	4		

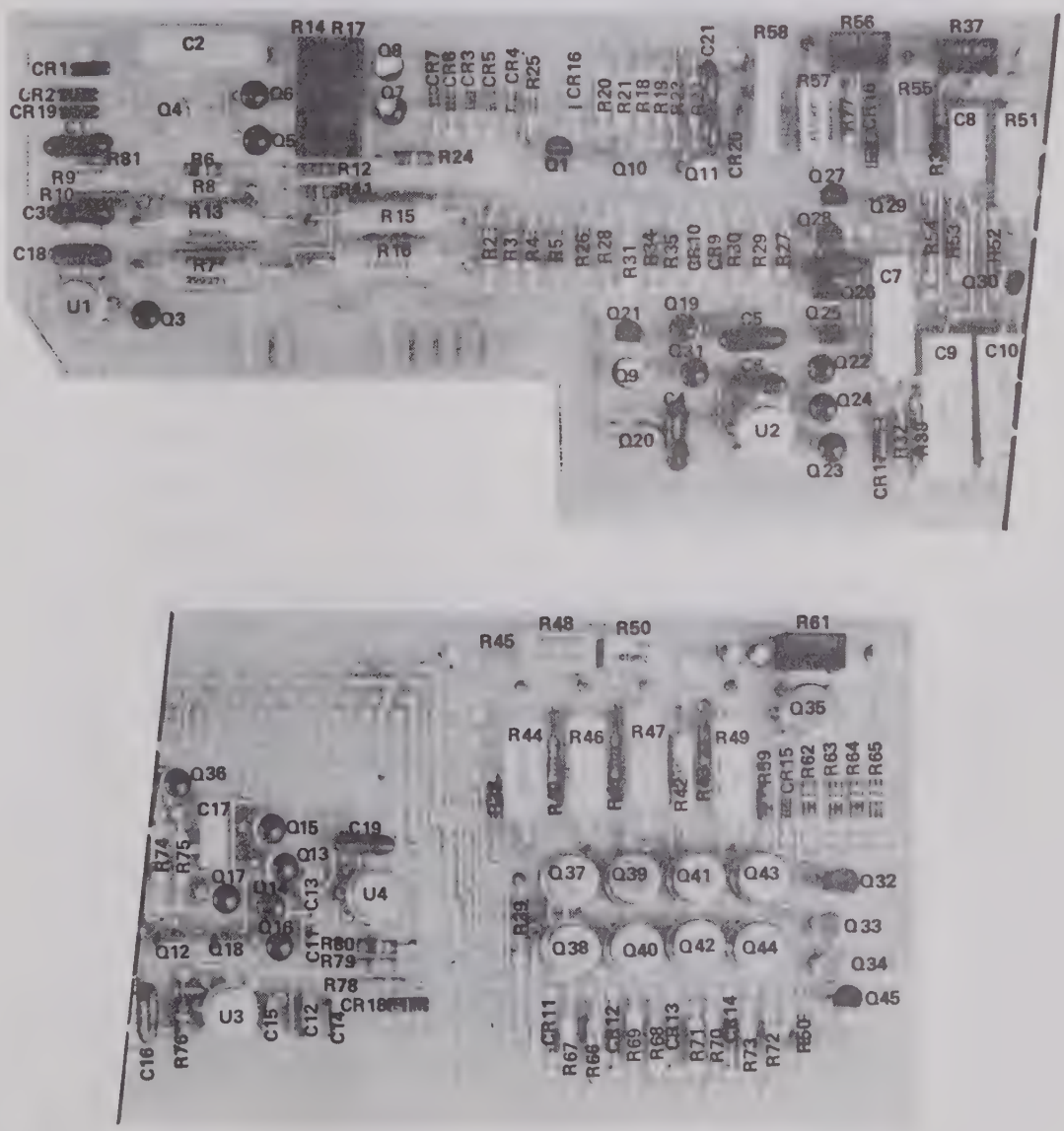


Figure 5-5. A TO D CONVERTER PCB ASSEMBLY

A10, ACTIVE FILTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	ACTIVE FILTER PCB ASSEMBLY				
A10	**Figure 5-6**	290346	REF		
C1 thru C4	Cap, plstc, 0.47 uf ±20%, 120V	190553	4		
C5, C8	Cap, mica, 33 pf ±5%, 500V	160317	2		
C6, C7	Cap, mica, 150 pf ±5%, 500V	148478	2		
CR1, CR2	Diode, silicon, 10 mA, 2 piv	180554	2		
CR3	Diode, silicon, 150 mA	203323	1		
K1	Relay, reed switch	219097	2		
	Coil, relay	272070	1		
Q1	Tstr, silicon, NPN, Super beta dual monolithic	284075	1		
Q2	Tstr, silicon, NPN	218396	1		
Q3	Tstr, silicon, PNP	195974	1		
R1, R2, R4, R5	Res, met flm, 46.4k ±1%, 1/8w	188375	4		
R3	Res, comp, 6.8k ±5%, 1/4w	148098	1		
R6	Res, met flm, 140k ±1%, 1/8w	289439	1		
R7	Res, comp, 100k ±5%, 1/4w	148189	1		
R8	Res, met flm, 8.66k ±1%, 1/8w	260364	1		
R9, R10	Res, met flm, 215k ±1%, 1/8w	289470	2		
R11, R12	Res, factory selected value				
R13	Res, var, cer met, 5k ±20%, 1/2w	267872	1		
R14	Res, met flm, 100k ±1%, 1/8w	248807	1		
R15	Res, met flm, 2.49k ±1%, 1/8w	226209	1		
R16	Res, met flm, 82.5k ±1%, 1/8w	246223	1		
R17	Res, met flm, 2k ±1%, 1/8w	235226	1		
R18	Res, met flm, 7.15k ±1%, 1/8w	260356	1		
U1, U2	IC, operational amplifier	271502	2		

A10, ACTIVE FILTER PCB ASSEMBLY

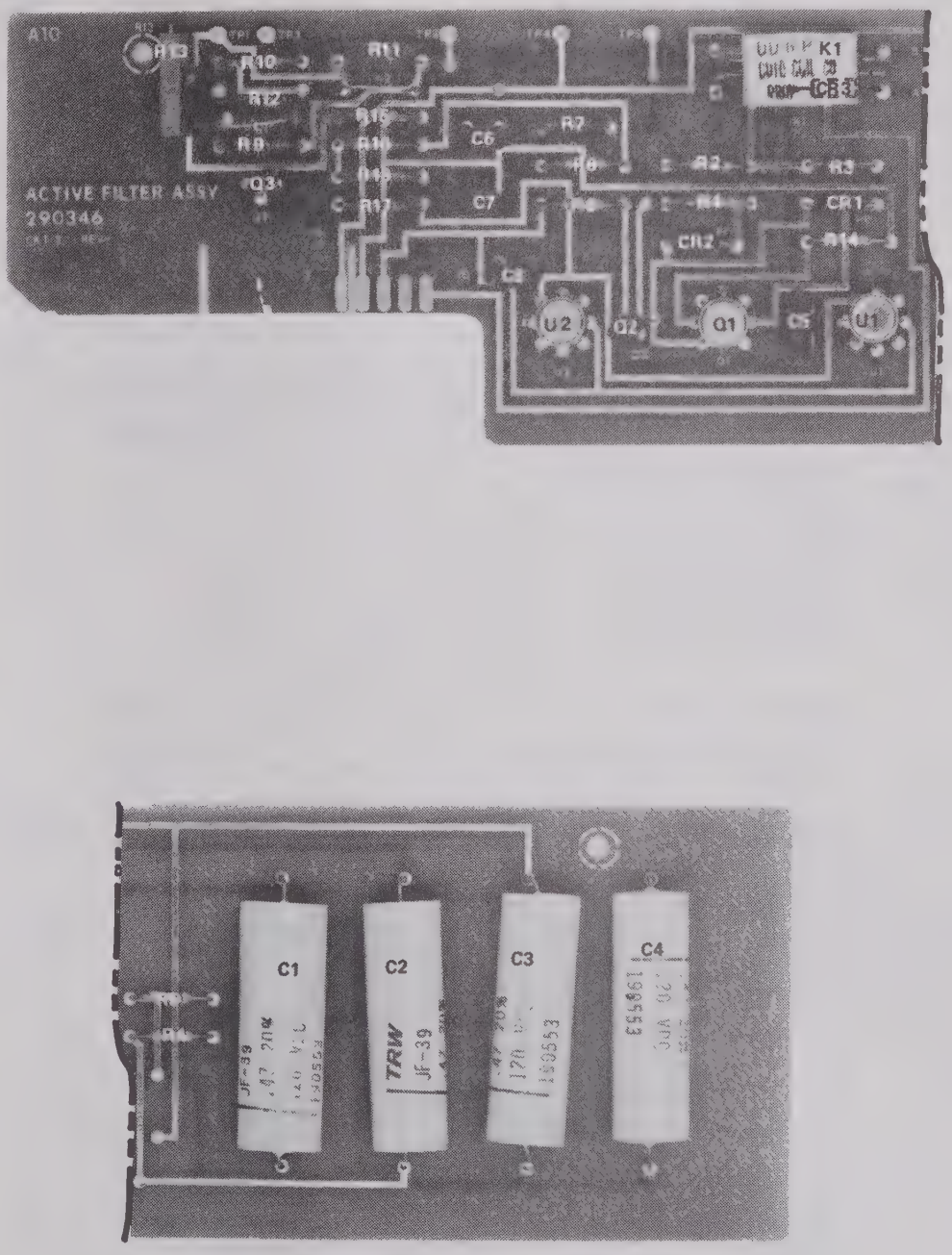


Figure 5-6. ACTIVE FILTER PCB ASSEMBLY

A11, BUFFER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A11	**BUFFER PCB ASSEMBLY** **Figure 5-7**	288191	REF		
C1, C3	Cap, mica, 100 pf ±5%, 500V	148494	2		
C2, C4	Cap, mica, 33 pf ±5%, 500V	160317	2		
C5	Cap, mica, 270 pf ±5%, 500V	148452	1		
C6, C7	Cap, cer, 0.05 uf ±20%, 100V	149161	2		
C8	Cap, plstc, 0.1 uf ±5%, 100V	167460	1		
C9, C10	Not Used				
C11	Cap, mica, 2200 pf ±5%, 500V	148346	1		
CR1,	Diode, silicon, 10 mA, 2 piv	180554	1		
CR3	Diode, zener, 6.8V	166199	1		
CR4 thru CR8	Diode, silicon, 200 mA, 25 piv	190272	5		
CR9 thru CR17	Diode, gremanium, 80 mA, 100 piv	149187	9		
CR18 thru CR24	Diode, silicon, 150 mA	203323	7		
K1, K7	Relay, 4 PDT, 5V coil	272716	2		
K2	Relay, reed switch Coil, relay	284091 272070	2 1		
K3	Relay, reed switch Coil, relay	284091 269019	REF 4		
K4, K5, K6	Relay, reed switch Coil, relay	289850 269019	3 REF		
Q1, Q8	Tstr, silicon, PNP	195974	2		
Q2	Tstr, germanium, PNP	148643	1		
Q3	Tstr, silicon, NPN	168716	1		
Q4	Tstr, silicon, NPN, dual, monolithic	295717	1		
Q5	Tstr, silicon, NPN, Super beta dual monolithic 1	284075	1		
Q6, Q7	Tstr, silicon, PNP, selected	280198	2		
Q9 Q10	Not Used				
Q11	Tstr, selected	321638	1		
R1	Res, comp, 1M ±5%, 1/4w	182204	1		
R2	Res, comp, 47k ±5%, 1/2w	150219	1		
R4	Not Used				

A11, BUFFER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R3	Res, comp, 910k ±5%, 2w	110171	1		
R5, R6 R7 R10	Res, ww, 4.45M Res, ww, 899.55k Res, ww, 99.95k Matched Input Divider Set	284505	1		
R8	Res, var, cer met, 1k ±20%, 1/2w	267856	1		
R9	Res, var, cer met, 100Ω ±20%, 1/2w	267823	1		
R11	Res, met flm, 10k ±1%, 1/8w	168260	1		
R12	Res, met flm, 13.7k ±1%, 1/8w	236752	1		
R13	Res, met flm, 34k ±1%, 1/8w	261602	1		
R14	Res, met flm, 2.61k ±1%, 1/8w	289983	1		
R15	Res, met flm, 232Ω ±5%, 1/8w	289975	1		
R16	Res, met flm, 100k ±1%, 1/8w	248807	1		
R17	Res, var, cer met, 100k ±20%, 1/2w	268581	1		
R18, R19	Res, comp, 100M ±10%, 1/2w	190520	2		
R20, R33	Res, comp, 10k ±5%, 1/4w	148106	2		
R21	Res, comp, 270k ±5%, 1/4w	220061	1		
R22, R23, R25, R26	Res, met flm, factory selected value (may not be installed)				
R24, R27	Res, met flm, 2M, Matched Set	290320	1		
R28	Res, var, cer met, 10k ± 10%, 1w	285171	1		
R29	Res, met flm, 3.83M ±1%, 1/2w	289660	1		
R30, R31	Res, comp, 22k ±5%, 1/4w	148130	2		
R32	Res, comp, 470Ω ±5%, 1/4w	147983	1		
R34	Res, comp, 3.3k ±5%, 1/4w	148056	1		
R35 R37 R39	Res, ww, 90k Res, ww, 9k Res, ww, 1k Matched Output Divider Set	289686	1		
R36	Res, var, cer met, 200Ω ±20%, 1/2w	284711	1		
R38	Res, var, cer met, 20Ω ±20%, 1/2w	261180	1		
R40	Res, comp, 1Ω ±5%, 1/2w	218693	1		
R41	Res, met flm, 499k ±1%, 1/8w	268813	1		
R42	Res, comp, 1k ±5%, 1/4w	148023	1		

A11, BUFFER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R43, R44	Res, comp, 330Ω ±5%, 1/4w	147967	2		
U1	IC, operational amplifier [1]	284760	1		
U2	IC, operational amplifier	271502	1		
U3	IC, voltage follower	288365	1		
U4	IC, DTL, Quad 2-Input Nand Power Gate	288597	1		
	Socket, IC, U4	276527	1		
	Cover (not shown)	298893	1		

[1] Replacement of this part requires factory recalibration. Return A11 Buffer PCB only.

A11, BUFFER PCB ASSEMBLY

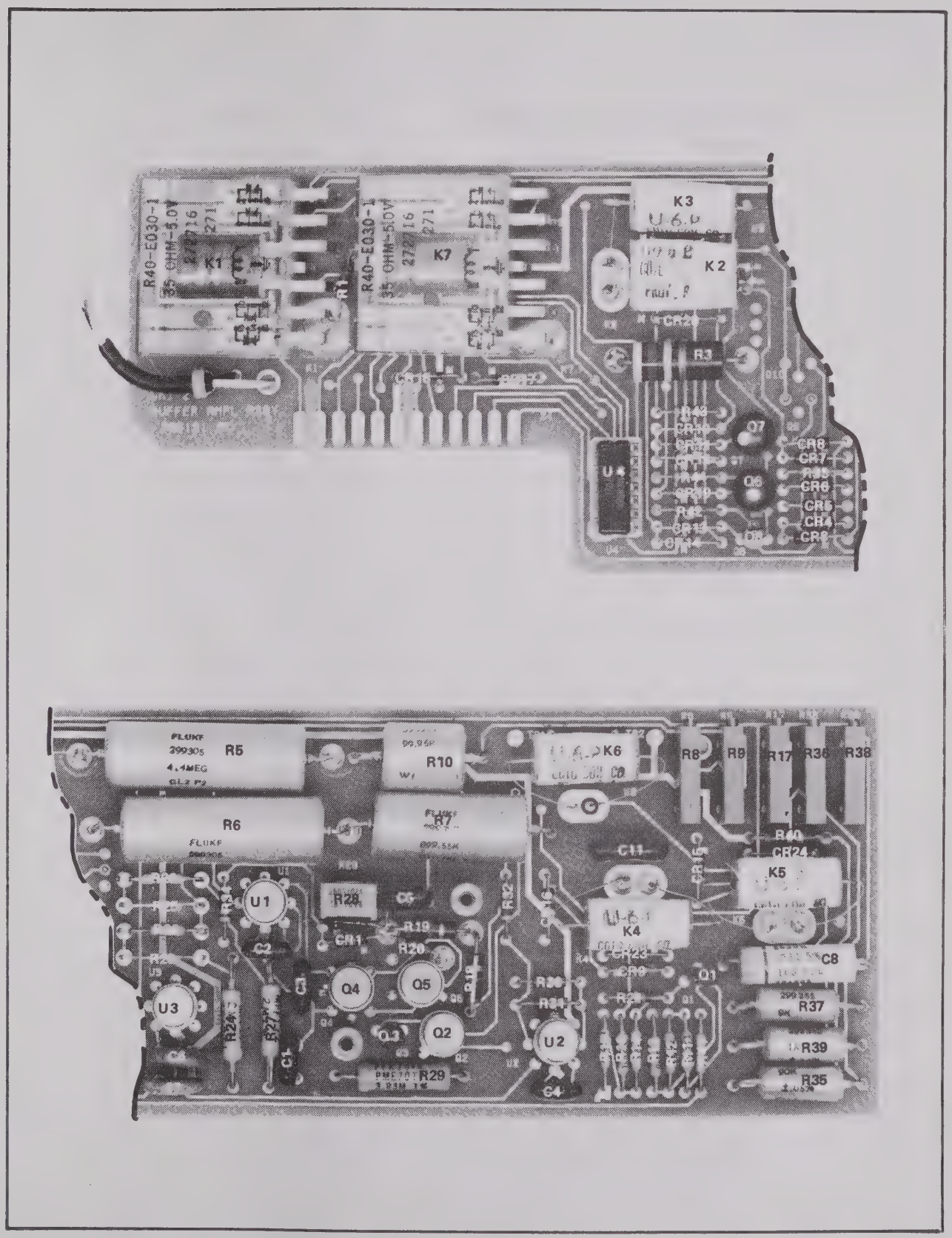


Figure 5-7. BUFFER AMPLIFIER PCB ASSEMBLY

A12, OHMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A12	**OHMS CONVERTER PCB ASSEMBLY** **Figure 5-8**	288217	REF		
C1	Cap, elect, 160 uf +50/−10%, 25V	236901	1		
C2, C7	Cap, cer, 0.01 uf ±20%, 100V	149153	2		
C3, C4	Cap, mica, 33 pf ±5%, 500V	160317	2		
C5	Cap, Ta, 1.0 uf ±20%, 35V	161919	1		
C6	Cap, mica, 470 pf ±5%, 500V	148429	1		
CR1	Diode, silicon, 1 amp, 100 piv	116111	1		
CR2	Diode, zener, 20V	180463	1		
CR3	Diode, zener, 6.3V, selected & tested	288043	1		
CR4	Diode, silicon, 150 mA, 125 piv	272252	1		
CR5	Diode, zener, 10V	180406	1		
CR6 thru CR13, CR16 thru CR20	Diode, silicon, 150 mA	203323	13		
CR14	Diode, silicon, 1 amp, 600 piv	112383	1		
CR15	Diode, germanium, 80 mA, 100 piv	149187	1		
F1	Fuse, pigtail, 15 mA, 125V (one fuse provided as a spare)	285031	2		
K1	Relay, reed switch	219097	2		
	Coil, relay	272070	1		
K2	Relay, armature, DPDT, 115V Coil	309633	1		
K3, K4	Relay, reed switch	284091	2		
	Coil, relay	269019	2		
Q1	Tstr, silicon, NPN	150359	1		
Q2, Q3	Tstr, silicon, PNP	225599	2		
Q4, Q7	Tstr, silicon, NPN	218396	2		
Q5, Q6	Tstr, silicon, PNP, selected	280198	2		
Q8	Tstr, silicon, PNP	195974	1		
R1, R9, R29	Res, comp, 10k ±5%, ¼w	148106	3		
R2, R4	Res, met flm, 10k ±1%, 1/8w	168260	2		
R3	Res, comp, 2.2k ±5%, ¼w	148049	1		

A12, OHMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5	Res, met flm, 953Ω ±1%, ½w	288555	1		
R6	Res, met flm, 619k ±1%, 1/8w	288639	1		
R7, R19	Res, var, cer met, 1k ±20%, ½w	267856	2		
R8, R17	Res, var, cer met, 25k ±20%, ½w	285213	2		
R10	Res, var, cer met, 10k ±20%, ½w	267880	1		
R11	Res, met flm, 46.4k ±1%, 1/8w	188375	1		
R12	Res, ww, 634.13Ω ±0.05%, ¼w	292888	1		
R13	Res, met flm, 464k ±1%, 1/8w	271908	1		
R14	Res, var, cer met, 100k ±20%, ½w	268581	1		
R15	Res, ww, 6.983k ±0.05%, ¼w	292896	1		
R16	Res, ww, 62k ±0.05%, ¼w	292904	1		
R18	Res, met flm, 6.99M ±0.1%, 2w	284968	1		
R20	Res, ww, 777.15k ±0.05%, 3/4w	277913	1		
R21	Res, var, cer met, 100Ω ±20%, ½w	267823	1		
R22	Res, ww, 70.555k ±0.05%, ½w	277905	1		
R23	Res, met flm, 100Ω ±1%, 1/8w	168195	1		
R24, R25	Res, comp, 390Ω ±5%, ¼w	147975	2		
R26	Res, comp, 8.2k ±5%, ¼w	160796	1		
R27	Res, comp, 4.7k ±5%, ¼w	148072	1		
R28	Res, comp, 1k ±5%, ¼w	148023	1		
R30, R31	Res, comp, 560Ω ±5%, ¼w	147991	2		
R32	Res, comp, 220Ω ±5%, ¼w	147959	1		
U1	IC, operational amplifier	271502	1		
U2	IC, operational amplifier	284760	1		
U3	IC, DTL, triple 3-Input Nand Gate	266312	1		
U4	IC, DTL, dual 4-Input Nand	268383	1		
U5	IC, DTL, Quad 2-Input Nand Gate	268375	1		
	Fuse holder	296582	2		
	Socket, IC, 14 contact, U3, U4, U5	276527	3		

A12, OHMS CONVERTER PCB ASSEMBLY

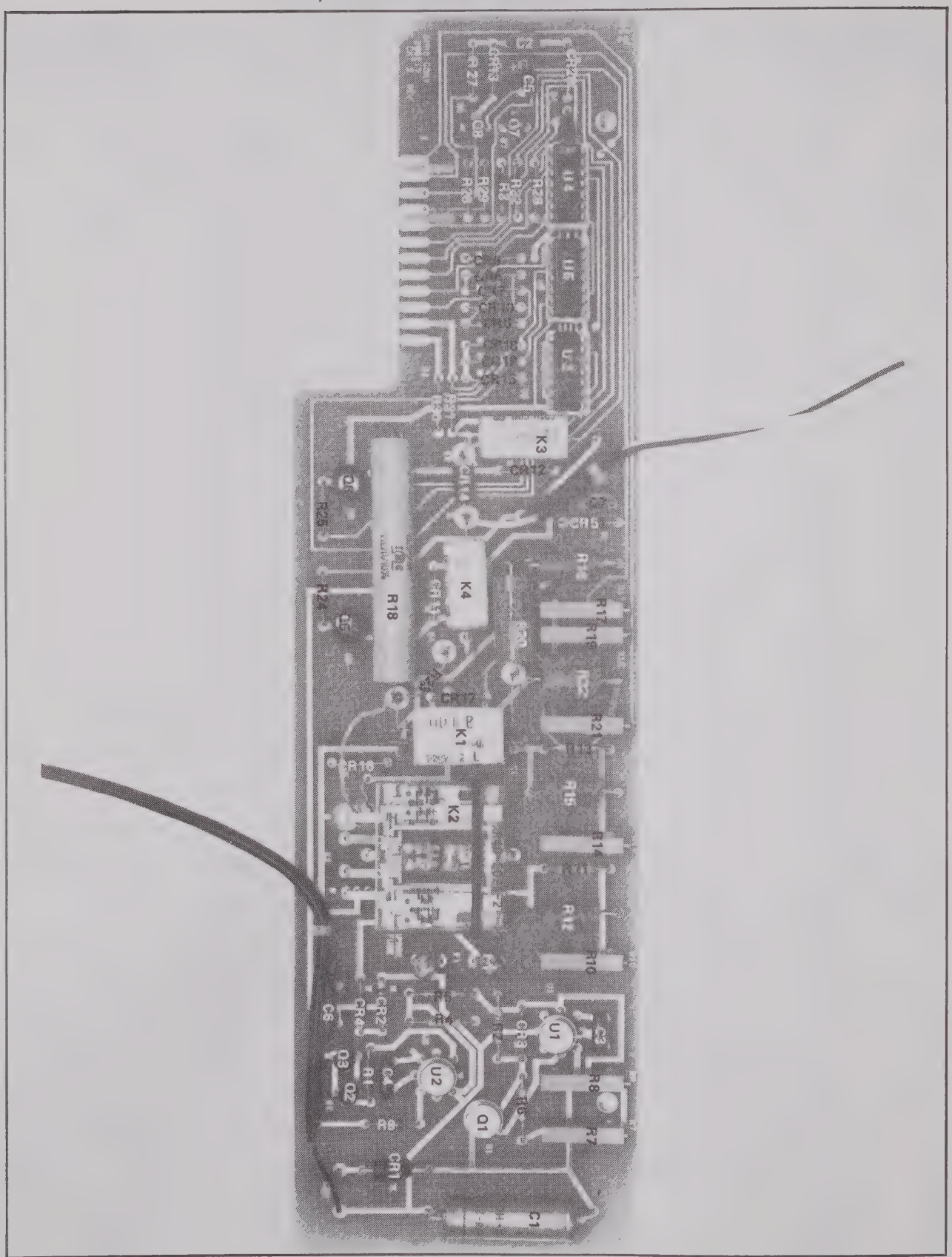


Figure 5-8. OHMS CONVERTER PCB ASSEMBLY

A13, TRUE RMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A13	RMS CONVERTER PCB ASSEMBLY Figure 5-9	339309	REF		
C1	Cap, plstc, 0.22 uf ± 20%, 1200V	268904	1		
C2	Cap, porc, 2.7 pf ± 0.25 pf, 1700V	340745	1		
C3	Cap, mica, 220 pf ± 5%, 500V	170423	1		
C4,C9	Cap, var, teflon, 0.25 – 1.5 pf, 2kV	218206	2		
C5	Cap, mica, 22 pf ± 5%, 500V	148551	1		
C6	Cap, mica, 8 pf ± 10%, 500V	216986	1		
C7,C34	Cap, plstc, 0.1 uf ± 10%, 250V	161992	2		
C8	Cap, porc, 2.2 pf ± 0.25 pf, 1700V	340273	1		
C10	Cap, porc, 27 pf ± 5%, 500V	344283	1		
C11	Cap, var, air, 0.8 – 10 pf, 250V	229930	1		
C12,C16, C41,C42	Cap, plstc, 0.047 uf ± 10%, 250V	162008	4		
C13	Cap, mica, 330 pf ± 1%, 500V	226142	1		
C14	Cap, var, cer, 9 – 35 pf, 350V	289637	1		
C15	Cap, mica, 3600 pf ± 2%, 500V	176644	1		
C17	Cap, mica, 15 pf ±5%, 500V	148569	1		
C18,C20	Cap, mica, 27 pf ±5%, 500V	177998	2		
C19,C22	Cap, mica, 1000 pf ±5%, 500V	178387	2		
C21,C40	Cap, mica, 2 pf ±0.5 pf, 500V	175208	2		
C23,C36, C37	Cap, Ta, 15 uf ± 10%, 20V	153056	3		
C24	Not Used				
C25	Cap, mica, 390 pf ± 5%, 500V	148437	1		
C26,C31, C38	Cap, mica, 33 pf ± 5%, 500V	160317	3		
C27,C30	Cap, plstc, 6800 pf ± 10%, 250V	342881	2		
C28,C29	Cap, plstc, 0.022 uf ± 10%, 250V	234484	2		
C32,C35	Cap, plstc, 0.033 uf ± 10%, 250V	234492	2		
C33	Cap, plstc, 4700 pf ± 10%, 250V	342873	1		

A13, TRUE RMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
C39	Not Used				
CL1	Current regulator FET	285106	1		
CR1 thru CR5	Diode, germanium, 80 mA, 100 piv	149187	5		
CR6,CR7, CR20	Diode, silicon, 100 mA at 1.5V	261370	3		
CR8,CR9, CR10,CR11, CR17,CR23	Diode, silicon, 150 mA	203323	6		
CR12,CR13	Not Used				
CR14,CR16	Diode, silicon, 100 mA at 1.5V	161810	2		
CR15,CR18	Diode, zener, 10V	246611	2		
CR19	Diode, silicon, 10 mA, 2 piv	180554	1		
CR21,CR22	Diode, zener, 6.8V	260695	2		
K1,K3	Relay, reed switch Coil, relay Foil wrap	284091 269019 313833	2 5 2		
K2A,K2B, K4,K5,K6	Relay reed switch Coil, relay (K2) Coil, relay (K4,K5,K6) Foil wrap (K4,K5,K6)	289850 272070 269019 280008	5 1 REF 3		
Q1	Tstr, FET, dual, N-channel	267963	1		
Q2,Q6,Q7	Tstr, FET, N-channel	343103	3		
Q3,Q9,Q10, Q18	Tstr, silicon, NPN	218396	4		
Q4,Q11,Q15	Tstr, silicon, PNP	195974	3		
Q5,Q13,Q14 Q16,Q17	Tstr, FET, N-channel	288324	5		
Q8,Q12	Part of matched set	1	1		
R1	Res, met flm, 1M ± 0.1%, 1w	340265	1		
R2,R11	Res, comp, 12k ± 5%, ¼w	159731	2		
R3,R4,R5, R47	Res, comp, 51k ± 5%, ¼w	193334	4		
R6,R7,R31	Res, met flm, 50k ± 0.1%, 1/8w	340257	3		

A13, TRUE RMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R8	Res, met flm, 48.7k ± 1%, 1/8w	267385	1		
R9,R20, R35,R53, R59,R67, R70	Res, comp, 1M ± 5%, ¼w	182204	7		
R10	Res, comp, 390Ω ± 5%, ¼w	147975	1		
R12,R42, R45	Res, var, cermet, 1M ± 10%, ½w	334722	3		
R13	Res, met flm, 995k ± 0.1%, ½w	340158	1		
R14,R64	Res, var, cermet, 10k ± 10%, ½w	385171	2		
R15	Res, met flm, 110.6k ± 0.1%, 1/8w	340224	1		
R16	Res, var, cermet, 1k ± 10%, ½w	285155	1		
R17	Res, met flm, 10.05k ± 0.1%, 1/8w	340216	1		
R18	Res, var, cermet, 100Ω ± 10%, ½w	285130	1		
R19	Res, met flm, 1.001k ± 0.1%, 1/8w	340208	1		
R21,R72, R75	Res, comp, 22k ± 5%, ¼w	148130	3		
R22	Res, comp, 300k ± 5%, ¼w	234682	1		
R23	Res, met flm, 4.975k ± 0.1%, 1/8w	340232	1		
R24	Res, comp, 5.1k ± 5%, ¼w	193342	1		
R25	Not Used				
R26	Res, comp, 3.9k ± 5%, ¼w	148064	1		
R27	Res, met flm, 1M ± 1%, 1/8w	268797	1		
R28	Res, met flm, 100Ω ± 1%, 1/8w	168195	1		
R29	Res, met flm, 5k ± 0.1%, 1/8w	340240	1		
R30,R37	Res, comp, 6.8k ± 5%, ¼w	148098	2		
R32	Res, var, cermet, 50Ω ± 10%, ½w	285122	1		
R33	Res, met flm, 100k ± 0.1%, 1/8w	340166	1		
R34	Res, met flm, 35.7k ± 1%, 1/8w	288480	1		
R36	Res, comp, 68Ω ± 5%, ¼w	247918	1		
R38	Res, var, cermet, 3Ω ± 25% ½w	347963	1		
R39	Not Used				

A13, TRUE RMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R40	Res, comp, 5.6k ± 5%, ¼w	148080	1		
R41	Res, comp, 56k ± 5%, ¼w	170738	1		
R43,R82	Res, comp, 1k ± 5%, ¼w	148023	2		
R44	Res, comp. 9.1k ± 5%, ¼w	193318	1		
R46	Res, comp, 560Ω ± 5%, ¼w	147991	1		
R48	Part of matched set, may not be installed	1	1		
R49,R83	Res, comp, 330Ω ± 5%, ¼w	147967	2		
R50	Res, comp, 100Ω ± 5%, ¼w	147926	1		
R51,R77	Res, comp, 82k ± 5%, ¼w	188458	2		
R52	Res, met flm, 2M ± 1%, ¼w	340323	1		
R54,R60	Res, comp, 470Ω ± 5%, ¼w	147983	2		
R55,R66	Res, var, cermet, 1M ± 10%, ½w	276691	2		
R56,R65	Res, met flm, 1M ± 0.25%, ¼w	340133	2		
R57	Res, met flm, 465k ± 0.25%, 1/8w	340315	1		
R58	Res, met flm, 499k ± 1%, 1/8w	268813	1		
R61	Res, met flm, 8.87k ± 1%, 1/8w	294967	1		
R62	Res, met flm, 17k ± 1%, 1/8w	236802	1		
R63	Res, met flm, 34k ± 1%, 1/8w	261602	1		
R68	Res, comp, 200k ± 5%, ¼w	248781	1		
R69	Res, comp, 750k ± 5%, ¼w	221937	1		
R71	Res, comp, 470k ± 5%, ¼w	188441	1		
R73	Res, comp, 47k ± 5%, ¼w	148163	1		
R74	Res, comp, 20k ± 5%, ¼w	221614	1		
R76	Res, comp, 180k ± 5%, ¼w	193441	1		
R78	Res, met flm, 10Ω ± 1%, 1/8w	268789	1		
R79,R80	Part of matched set, one or none may be installed	1			
R81	Not Used				
S1	Switch, slide SPDT	271478	1		
U1	IC, DTL, triple 3-Input Nand Gate	266312	1		
U2	IC, DTL, Quad 2-Input Nand Gate	288597	1		

A13, TRUE RMS CONVERTER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
U3	IC, operational amplifier	329912	1		
U4	IC, operational amplifier	225961	1		
U5	IC, operational amplifier	288928	1		
U6,U7	IC, operational amplifier	284760	2		
U8	IC, operational amplifier	271502	1		
	Cable, Input	304048	1		
	Heat dissipator	347732	1		
	Cover, pcb	339366	1		

1 Q8, Q12, R48, R79, and R80 form a factory matched set. If any of these components require replacement, complete set must be installed. Order "TC Matched Set" part number 361048.

A13, TRUE RMS CONVERTER PCB ASSEMBLY

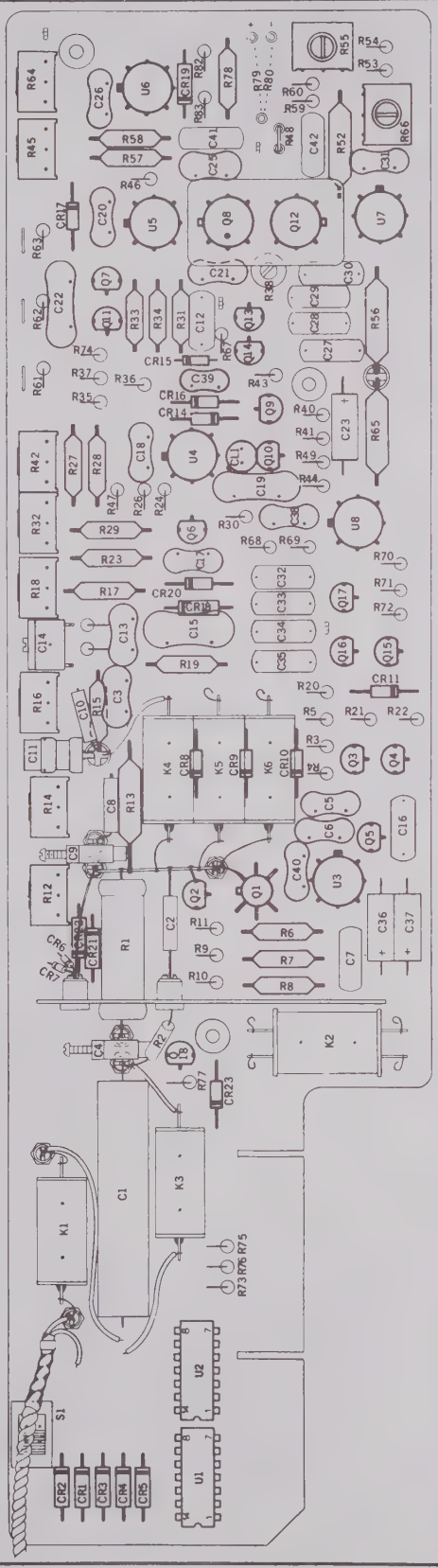


Figure 5-9. TRUE RMS CONVERTER PCB ASSEMBLY

A14, DISPLAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A14	**DISPLAY PCB ASSEMBLY** Figure 5-10	288167	REF		
C1	Cap, cer, 0.05μf ± 20%, 50V	149161	1		
C2,C100	Cap, cer, 1200 pf ± 10%, 500V	106732	2		
C3	Cap, elect, 20μf +50/−10%, 16V	241356	1		
C4	Cap, cer, 0.025μf ± 20%, 50V	168435	1		
C5	Cap, cer, 2200 pf ± 10%, 500V	268425	1		
C6,C103	Cap, cer, 0.01μf ± 20%, 100V	149153	2		
C101	Cap, cer, 500 pf ± 10%, 500V	105692	1		
C102	Cap, cer, 0.025μf ± 20%, 50V	175232	1		
CR1,CR2, CR7,CR10, CR12,CR16, CR18,CR19, CR25 thru CR30,CR32	Diode, germanium, 80mA, 100 piv	149187	15		
CR3,CR4 CR17,CR20, thru CR24	Not Used				
CR5,CR6, CR8,CR9, CR11,CR13, thru CR15, CR31,CR33, CR34	Diode, silicon, 150mA	203323	11		
DS1	Lamp, incandescent, 5V	272476	1		
J1,J10	Connector, female, 12 contact	291898	2		
J2,J5,J7, J8,J11, J12,J13	Connector, female, 24 contact	295352	7		
J3,J4,J9	Connector, female, 24 contact with 6 removed	284240	3		
J14	Connector, female, 18 contact	291906	1		
Q1,Q21	Not Used				
Q2,Q5	Tstr, silicon, PNP	195974	2		
Q3,Q6, Q7,Q19, Q20,Q34 Q35,Q36	Tstr, silicon, NPN	218396	8		
Q4,Q8	Tstr, silicon, unijunction	268110	2		

A14, DISPLAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q9 thru Q18	Tstr, silicon, NPN	245480	10		
Q22 thru Q26	Tstr, silicon, NPN	218511	5		
Q27 thru Q31	Tstr, silicon, PNP	266619	5		
Q33,Q33	Tstr, FET, N-channel	288324	2		
Q37	Tstr, silicon, NPN	168708	1		
R1,R3,R60	Not Used				
R2,R4	Res, comp, 82k ± 5%, 1/4w	188458	2		
R5	Res, comp, 6.8k ± 5%, 1/4w	148098	1		
R6,R11, R20,R25	Res, comp, 3.9k ± 5%, 1/4w	148064	4		
R7,R58	Res, comp, 470Ω ± 5%, 1/4w	147983	2		
R8,R18	Res, comp, 2.7k ± 5%, 1/4w	170720	3		
R9	Res, comp, 1.2k ± 5%, 1/4w	190371	4		
R10	Res, comp, 510Ω ± 5%, 1/4w	218032	1		
R12	Res, comp, 75k ± 5%, 1/4w	220525	1		
R13,R30	Res, comp, 2.2k ± 5%, 1/4w	148049	2		
R14,R57	Res, comp, 33k ± 5%, 1/4w	148155	2		
R15	Res, comp, 27Ω ± 5%, 1/4w	160812	1		
R16	Res, var, comp, 150k ± 20%, 1/2w	267930	1		
R17	Res, comp, 1.8k ± 5%, 1/4w	175042	1		
R19,R48 thru R54 R64,R65	Res, comp, 10k ± 5%, 1/4w (R64 on bottom side of PCB)	148106	10		
R21,R22, R59	Res, comp, 390Ω ± 5%, 1/4w	147975	3		
R23,R24	Res, comp, 16k ± 5%, 1/4w	221606	2		
R26,R27, R28	Res, comp, 1.2k ± 5%, 1/4w	190371	REF		
R29,R34 thru R38, R61	Res, comp, 8.2k ± 5%, 1/4w	160796	7		
R31,R39	Res, comp, 430Ω ± 5%, 1/4w	203869	2		

A14, DISPLAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R32	Res, comp, 330Ω ± 5%, 1/4w	147967	1		
R33	Res, comp, 470k ± 5%, 1/4w	188441	1		
R40	Res, comp, 4.7k ± 5%, 1/4w	148072	1		
R41	Res, comp, 5.1k ± 5%, 1/4w	193342	1		
R42	Res, var, cer met, 100k ± 10%, 1w	288308	1		
R43 thru R46,R55, R56,R62	Res, comp, 39Ω ± 5%, 1/4w	193391	7		
R47	Res, comp, 3.3k ± 5%, 1/4w	148056	1		
R63	Res, comp, 12k ± 5%, 1/4w	159731	1		
	Switch Assembly	298232	1		
	Switch section, S1 thru S7, RANGE	288688	1		
	Switch section, S8 thru S14, FUNCTION	288670	1		
	Flex circuit	307504	1		
U1	IC, TTL, Hex Inverter Buffer Driver	288605	1		
U2,U3	IC, TTL, dual J-K flip flop	268441	2		
U4	IC, Decoder Driver, DM/SN7441AN, NS8840N	267211	1		
V1	Tub, polarity indicator	272922	1		
V2 thru V7	Tube, neon readout	271494	6		
	Display function assembly (lamp, P/N 272476 may be purchased separately)	298562	1		
	Socket, IC, 14 contact	291542	1		
	Socket, IC, 16 contact	291534	3		

A14, DISPLAY PCB ASSEMBLY

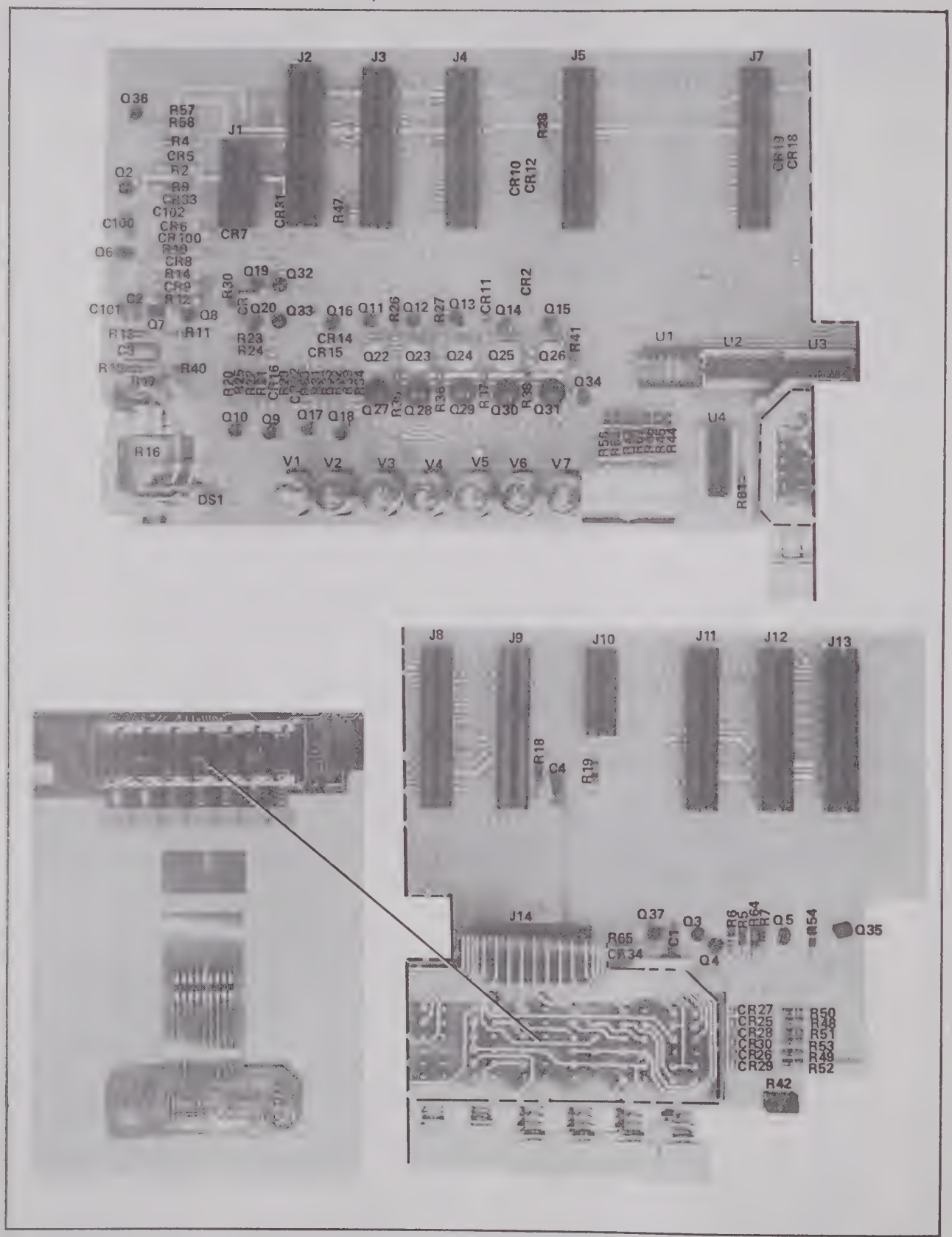


Figure 5-10. DISPLAY PCB ASSEMBLY

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
105668	56289	C023B501J103M
105692	71590	2DDH60N501K
105734	71590	BB60301KW7W
105890	71590	BB60181KS3N
106732	71590	CF122
108308	01121	EB4751
108951	01121	EB5115
110171	01121	HB9145
110726	07910	1N964B
112383	05277	1N4822
113316	07910	1N748
116111	05277	1N4817
144717	01121	EB5105
147892	01121	CB4705
147926	01121	CB1015
147934	01121	CB1515
147959	01121	CB2215
147967	01121	CB3315
147975	01121	CB3915
147983	01121	CB4715
147991	01121	CB5615
148007	01121	CB6815
148015	01121	CB8215
148023	01121	CB1025
148031	01121	CB1525
148049	01121	CB2225
148056	01121	CB3325
148064	01121	CB3925
148072	01121	CB4725
148080	01121	CB5625
148098	01121	CB6825
148106	01121	CB1035
148114	01121	CB1535
148122	01121	CB1835
148130	01121	CB2235
148148	01121	CB2735
148155	01121	CB3335
148163	01121	CB4735
148171	01121	CB6835
148189	01121	CB1045
148346	14655	CD19F222J
148361	14655	CD19F152J
148387	14655	CD19F102J
148429	14655	CD19F471J
148437	14655	CD15F391J
148452	14655	CD15F271J
148478	14655	CD15F151J
148494	14655	CD15F101J
148528	14655	CD15F560J
148536	14655	CD15E470J
148551	14655	CD15E220J
148569	14655	CD15C150J
148619	01295	2N1303
148643	01295	2N1307
149153	56289	C023B101F103M
149161	56289	55C23A1
149187	93332	1N270
149484	01121	CB8205
150359	95303	2N3053
152470	53021	D20F103F
153056	56289	150D156X9020B2
155192	91627	TYPE MFF 1/2
159731	01121	CB1235
159947	00656	TYPE C1-1
160226	05397	K2R2C20K
160317	14655	CD15E330J
160796	01121	CB8225
160804	01121	CB2715

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
160812	01121	CB2705
160937	01121	CB2245
161810	03877	SG5658
161919	56289	196D105X0035
161943	56289	196D475X0020
161992	73445	C280AEA100K
162008	73445	C280AEA47K
166199	07910	1N754
167460	84411	TYPE 863UW
168195	91637	TYPE MFF 1/8
168229	91637	TYPE MFF 1/8
168252	91637	TYPE MFF 1/2
168260	91637	TYPE MFF 1/8
168278	91637	TYPE MFF 1/2
168435	56289	C128B101H253M
168708	03508	2N3391
168716	07263	S19254
168823	73445	C426ARF50
170423	14655	CD15F221J
170720	01121	CB2725
170738	01121	CB5635
175042	01121	CB1825
175208	84141	DM15020K
175224	14655	CD15E120J
175232	56289	C023B101E502M
176644	14655	CD19F362G
177998	14655	CD15E270J
178616	73445	C437ARG250
180406	07910	1N758
180463	07910	1N968B
180505	18927	1N276
180554	07910	CD12599
182204	01121	CB1055
182212	01121	CB1545
182790	56289	150D684X9035A2
182873	14655	CD19F562G
182956	91637	TYPE MFF 1/8
184366	73445	C280AE/A470K
186296	73445	C426ARE125
187195	07910	CD36554
188375	91637	TYPE MFF 1/8
188441	01121	CB4745
188458	01121	CB8235
188466	01121	CB3935
190249	89536	190249
190272	93332	1N456A
190371	01121	CB1225
190520	01121	EB1071
190553	84411	TYPE 863UW
190728	89536	190728
193318	01121	CB9125
193334	01121	CB5135
193342	01121	CB5125
193391	01121	CB3905
193441	01121	CB1845
193458	01121	CB1245
194803	73445	C280AEA220K
194944	01121	CB1065
195974	04713	2N3906
198390	01121	CB2255
200030	91637	RN55D1820F
203323	03508	DHD1105
203869	01121	CB4315
208975	14655	CD19F472J
216986	14655	CD15C080K
218081	04713	MPS6520
218206	72982	530–000
218396	04713	2N3904

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
218511	95303	60994
218693	01121	EB1065
219097	15898	765972
220061	01121	CB2735
220525	01121	CB7535
220541	01121	CB8245
221580	01121	CB1135
221606	01121	CB1635
221614	01121	CB2035
221903	01121	CB6215
221911	01121	CB6225
221937	01121	CB7545
221952	01121	CB3055
221960	01121	CB6255
225599	07263	S22650
226134	14655	CD15F151F500
226209	91637	TYPE MFF 1/8
226274	82389	46256LFE
226316	00656	TYPE MFF C1-1
229146	91637	TYPE MFF 1/8
229484	91637	TYPE MFF 1/8
229492	91637	TYPE MFF 1/8
229898	04713	MPS6522
229930	91293	JMC2951
234484	73445	C280AEA22K
234492	73445	C280AEA33K
234682	01121	CB3045
234708	91637	TYPE MFF 1/8
234971	91637	TYPE MFF 1/8
235266	91637	TYPE MFF 1/8
235234	91637	TYPE MFF 1/8
235309	91637	TYPE MFF 1/8
235333	91637	TYPE MFF 1/8
236752	91637	TYPE MFF 1/8
236802	91637	TYPE MFF 1/8
236901	91637	C437ARF160
236935	73445	C426ARD200
237206	91637	TYPE MFF 1/8
237297	91637	TYPE MFF 1/8
240937	89536	240937
241091	91637	TYPE MFF 1/8
241356	73445	C426ARE20
241471	91637	TYPE MFF 1/8
241497	91637	TYPE MFF 1/8
245480	07263	S24496
246066	04713	EL131
246223	91637	TYPE MFF 1/8
246611	07910	1N961B
248807	91637	TYPE MFF 1/8
248906	95303	CA3046
249052	07910	1N963B
249284	89536	249284
256479	71450	TYPE 45
257501	17856	DN423
260356	91637	TYPE MFF 1/8
260364	91637	TYPE MFF 1/8
260547	91637	TYPE MFF 1/8
260554	07910	CD55105
260562	84411	863UW47391
260695	07910	1N754A
261180	71450	190PC200B
261370	22767	S1330
261388	04713	SPF179
261602	91637	TYPE MFF 1/8
261651	91637	TYPE MFF 1/8
261842	01121	CB6205
261883	91637	TYPE MFF 1/8
266312	04713	MC862P
266619	07263	2N4888
267120	73445	C280AE/A27K
267153	04713	MC839P
267211	89536	267211

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
267385	91637	TYPE MMF 1/8
267823	71450	190PC200B
267856	71450	190PC102B
267872	71450	190PC502B
267880	71450	190PC103B
267963	17856	DN503
268011	AMI	T-1483
268110	03508	2N6027
268367	04713	MC836P
268375	04713	MC846P
268383	01295	SN15832N
268441	18324	C4312A
268540	18324	C4319A
268557	18324	C4321A
268581	71450	190PC104B
268789	91637	TYPE MFF 1/8
268797	91637	TYPE MMF 1/8
268813	91637	TYPE MFF 1/8
268821	91637	TYPE MFF 1/8
268904	84411	TYPE X663F
269019	71707	U-6-P
269076	95303	2N4037
269092	89536	269092
271320	56289	150D335X5020B2
271361	91637	TYPE MFF 1/8
271403	54294	TYPE SP22
271411	54294	TYPE VA32
271478	81741	TYPE 23–021
271494	83594	B5853ST
271502	12040	LM301A
271908	91637	TYPE MFF 1/8
271924	07910	CFE13041
272070	71707	UD-6-P
272096	91637	TYPE MFF 1/8
272138	12040	DM8570
272252	07263	FD333
272476	71744	TYPE T1
272716	77342	TYPE R40
272732	73445	C437ARD1600
272922	83594	B585-6ST
273151	74970	273-1-2
274795	89536	274795
275321	89536	275321
275362	89536	275362
275552	32767	820-65
275560	32767	820-45
275578	32767	820-55
275792	56289	39D805G350GE4
276527	23880	TSA-2900-14W
276535	23880	TSA-2900-16W
276691	11236	360T105A
277657	89536	277657
277665	89536	277665
277905	89536	277905
277913	89536	277913
278309	89536	278309
280198	89536	280198
281790	91637	TYPE MFF 1/8
281865	12615	SL-841-777
282145	56289	HVD3-47
283697	91637	TYPE MFF 1/8
284075	11726	QD200-78
284091	12617	TYPE MRR5
284174	70903	KHS-7041
284240	00779	TYPE 583650
284505	89536	284505
284711	71450	190PC201B
284760	12040	LM308H

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
284885	84411	863UW33351
284968	75042	TYPE MEH
284976	91637	TYPE MFF 1/4
285031	75915	279.015
285106	07910	CRE3021
285114	71450	360S-200B
285122	71450	360S-500A
285130	71450	360S-101A
285148	71450	360S201A
285155	71450	360S-102A
285163	71450	360S-202A
285171	71450	360S-103A
285189	91637	TYPE MFF 1/8
285213	71450	190PC253B
285239	89536	285239
285361	89536	285361
288043	89536	288043
288159	89536	288159
288167	89536	288167
288175	89536	288175
288183	89536	288183
288191	89536	288191
288209	89536	288209
288217	89536	288217
288225	89536	288225
288233	89536	288233
288308	71450	360S-104A
288324	15818	U2412
288365	12040	LM310H
288381	95303	40372
288480	91637	TYPE MFF 1/8
288498	91637	TYPE MFF 1/8
288555	91637	TYPE MFF 1/2
288563	91637	TYPE MFF 1/8
288597	04713	MC858P
288605	01295	SN7416P
288639	91637	TYPE MFF 1/8
288647	89536	288647
288654	89536	288654
288670	89536	288670
288688	89536	288688
288761	49956	RS2048
288803	01295	SN158097N
288811	01537	MC856P
288837	01295	SN74100N
288845	01295	SN7402N
288852	04713	MC8312P
288928	12040	LM308AH
289066	91637	TYPE MFF 1/8
289439	91637	TYPE MFF 1/8
289470	91637	TYPE MFF 1/8
289637	72982	538-006D-9-35
289660	00327	TYPE M12
289686	89536	289686
289850	12617	TYPE MRR2
289975	91637	TYPE MFF 1/8
289983	91637	TYPE MFF 1/8
290130	89536	290130
290148	89536	290148
290155	89536	290155
290163	89536	290163
290247	89536	290247
290262	89536	290262
290270	89536	290270
290296	89536	290296

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
290304	89536	290304
290312	89536	290312
290320	89536	290320
290346	89536	290346
290650	89536	290650
291120	71450	360S501A
291294	91637	TYPE MFF 1/8
291526	89536	291526
291534	00779	583529
291542	00779	583527
291690	89536	291690
291898	00779	583650-2
291906	00779	583650-3
292193	89536	292193
292201	89536	292201
292888	89536	292888
292896	89536	292896
292904	89536	292904
292946	71785	133-59-02-011
292953	01537	MC7400P
292979	01295	SN7404N
295121	89536	295121
295196	56289	39D718G010JP4
295337	28213	SF3402
295352	00779	583650-9
295535	89536	295535
295717	11726	QD101-78E
296582	75915	281005
297713	89536	297713
297762	89536	297762
297903	89536	297903
298232	89536	298232
298554	89536	298554
298893	89536	298893
298992	89536	298992
299610	89536	299610
301382	89536	301382
301390	89536	301390
303412	89536	303412
303461	89536	303461
306118	01295	GA3938A
306126	01295	GA3937A
307298	89536	307298
307504	89536	307504
309633	77342	TYPE R40
309849	72982	8131-050-651-224M
311746	89536	311746
321398	89536	321398
329912	12040	LM318H
334722	71450	360S105A
339309	89536	339309
340133	91637	TYPE MFF ¼
340158	91637	TYPE MFF ¼
340166	91637	TYPE MFF 1/8
340208	91637	TYPE MFF 1/8
340216	91637	TYPE MFF 1/8
340224	91637	TYPE MFF 1/8
340232	91637	TYPE MFF 1/8
340240	91637	TYPE MFF 1/8
340257	91637	TYPE MFF 1/8
340265	03888	TYPE PME 75
340273	95275	VY10CA2R2CA

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
340315	91637	TYPE MFF 1/8			
340323	91637	TYPE MFF ¼			
340745	95275	VY10CA2R7CA			
342873	73445	C280AEA10K			
342881	73445	C280AEA6K8			
344283	95275	VY10CA270JA			
347963	80294	3329H-J81-3R0			

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section contains information describing the options and accessories usable with this instrument.

6-3. OPTIONS

6-4. Each of the options usable with this instrument are described under headings that list the option name and number. The descriptions give detailed field installation, operating, and maintenance data for each option as well as a complete list of replaceable parts.

6-5. ACCESSORIES

6-6. Accessories usable with this instrument are described under headings that list the accessory name and number.

6-7. A listing of included options and accessories is given in the contents at the front of this manual.

Option–03
Data Output Unit

6-1. INTRODUCTION

6-2. The Data Output Unit (Option–03) provides data output that is completely isolated from the analog input and is available in 8-4-2-1 BCD logic level format. Data is transferred serially via guarded toroids from the Model 8375A to the Data Output Unit. Single decade code conversion and serial-character, parallel-bit acquisitions are unique capabilities, in addition to standard full parallel output.

6-3. SPECIFICATIONS

6-4. Specifications for the Data Output Unit are located in Section 1 of the manual.

6-5. INSTALLATION

6-6. The following procedure should be used to install the Data Output Unit in the Model 8375A.

a. Disconnect the power cord from the instrument before installing the Data Output Unit option.

b. Remove the top dust and guard chassis covers.

c. Determine that connector J7, on A14 Display board, is clear of obstructions and that alignment spacer is inserted between pin pairs J7-1, -2 and J7-3, -4. A second alignment spacer must be inserted between pin pairs J7-21, -22 and J7-23, -24.

d. Determine that connector slots on rear panel for P20 and P21 on Data Output Unit boards are clear of any obstructions.

e. Attach spring to bottom portion of guard bar on A7 Data Output Unit No. 1.

f. Insert P21, on A7 Data Output Unit No. 1, into connector slot on rear panel while inserting P20 on A6 Data Output Unit No. 2 into rear panel connector slot. (Refer to Section 5, Figure 5-1 for physical location of A7 and A6)

g. Insert edge of both the Data Output Units (A6 & A7) into card guides on the inner chassis bulkhead.

h. Observe that alignment spacers on J7 line up with slots on the Data Output Unit card-edge connector.

i. Slide both boards downward until the card-edge connector on A7 is fully engaged with J7 on A14 Display board, and A6 is seated into bracket.

j. Lay the twisted pair cable under the top position of the rear panel and route toward transformer.

j. Connect wires to jacks mounted on transformer so yellow mates to yellow and blue to blue.

k. Attach guard and dust covers, connect ac power, and perform receiving inspection test of the Data Output Units as described in paragraph 6-33, Performance Test.

6-7. OPERATING INSTRUCTIONS

6-8. Operating instructions and applications information for the Model 8375A with DOU installed are located in Section 2 of the manual.

6-9. THEORY OF OPERATION

6-10. General

6-11. The Data Output Unit (DOU) receives DMM measurement data through guarded pulse transformers and, by means of appropriate control circuitry, enters this data into a self-contained, random-access digital memory. Outputs are available in positive logic, BCD 8-4-2-1, full-parallel format. A strobing operation which produces a parallel-bit serial-character format may be easily implemented by connecting outputs together in groups, as desired, and manipulating gate inputs (see DOU block diagram, Figure 6-1).

6-12. A system of output blanking is incorporated which has a three fold purpose. First, it holds all outputs in an off state any time the DMM is performing a measurement or is in the digitizing process. It is during these periods that the DOU memory is being loaded; and if outputs were turned on, transient, meaningless data would be momentarily displayed. Secondly, signal conditioner settling time is automatically compensated for by a circuit called the programmed one-shot (POS). The POS ensures that the user obtains data at the rated accuracy, in the minimum possible time by holding outputs off (blanked) until valid data is obtainable. The advantages of this circuit are expecially apparent when the instrument is commanded to sample simultaneous application of a transient signal or

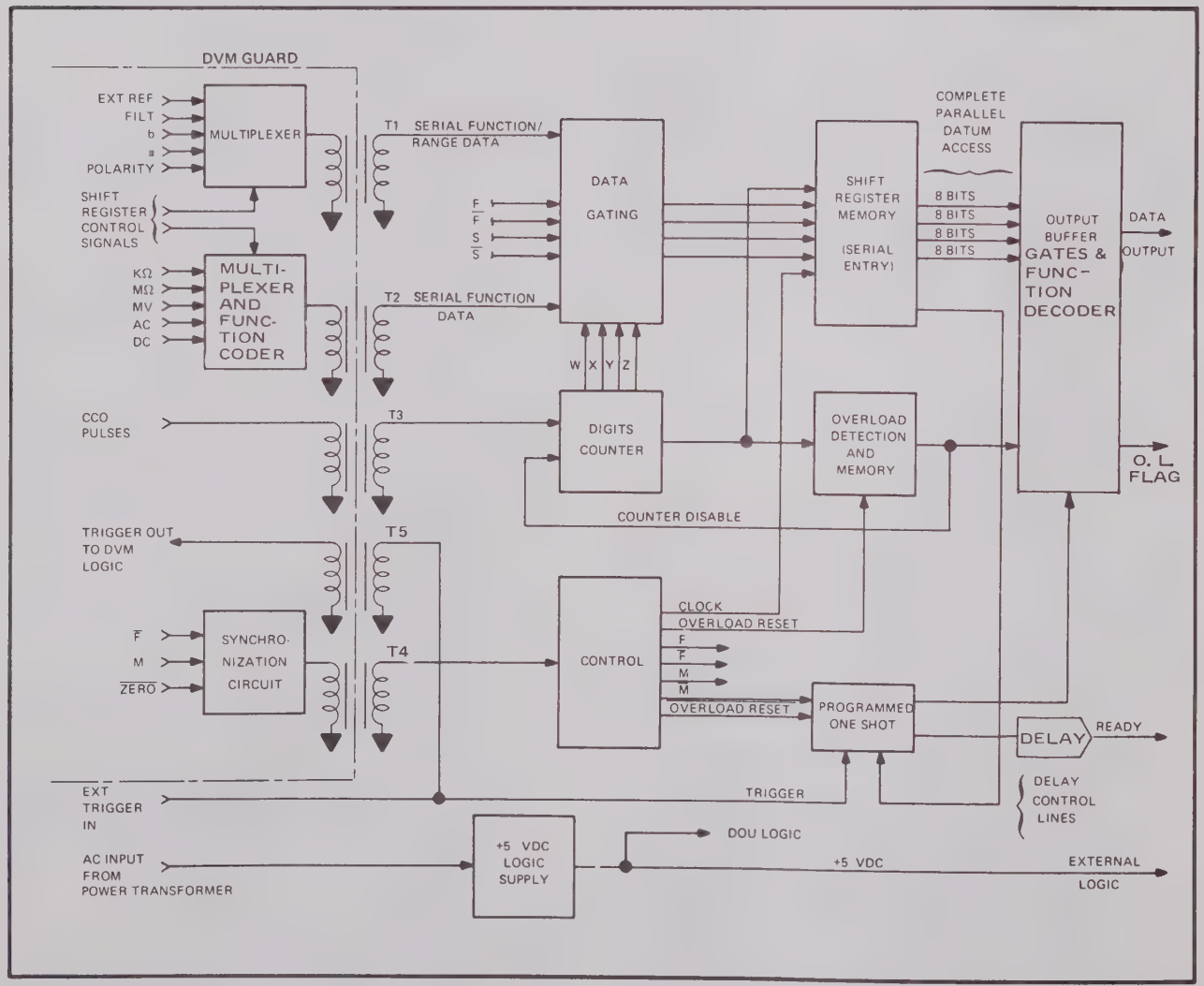


Figure 6-1. DATA OUTPUT UNIT BLOCK DIAGRAM.

step change to the DMM input. The POS holds outputs off just long enough for the signal conditioner in use to settle to rated accuracy. When a different signal conditioner is called into operation by the user, the POS automatically adjusts timeout delay to the new conditions. At timeout, the POS triggers a new measurement before turning on the outputs 23 milliseconds later. Thirdly, automatic ranging is detected by the DOU, and data outputs are blanked during operations associated with that function. After the blanking process is complete, the outputs will remain on and unchanged until the DMM is again commanded to sample.

6-13. Following is an example of a typical sequence of internal events as initiated by a user-generated sample command.

a. An unknown input and a trigger (command to sample) are applied simultaneously to the DMM

b. The POS reverts to its unstable state, thereby inhibiting all outputs.

c. The DMM makes a preliminary measurement, (requiring 6 milliseconds) to determine if ranging is necessary.

d. Autoranging takes place and the timeout is increased by 250 milliseconds for each range change.

e. The programmed one-shot begins to timeout in accordance with the function delay data registered in the DOU memory.

f. At the end of the required settling time, the DMM is automatically commanded to sample again by the POS as it reverts to its stable state.

g. New data is registered in the DOU memory as a result of this final sample.

h. All the outputs are then turned on to provide function, range, polarity, and specified-accuracy numerical data. A ready flag indicates whether outputs are on or off.

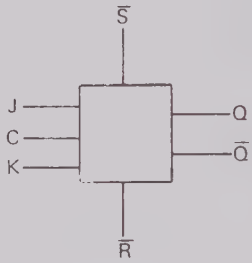
6-14. Circuit Description

6-15. LOGIC NOTATION. A description of the logic symbology used in the DOU is given in Figure 6-2. A J-K flip flop that is in the "1" condition, has a "high" output from the "Q" terminal. The orientation of the flip flops in the schematics is the same as the flip flops shown in Figure 6-2. This method of notation enables input/output terminals of the flip flops to be identified without the necessity of redundant lettering of each device symbol. The routing of logic and control signals on the schematics is accomplished withoug connecting lines which greatly reduces conjustion.

6-16. MULTIPLEXERS. The DMM function, range, and polarity inputs are applied to dual multiplexer circuitry consisting of NAND gates A7U27A through D, A7U28A through D, A7U29C and A7U29D, (see DOU schematic at rear of manual). The gates comprising each multiplexer are enabled sequentially by the 6-state shift register signals. The multiplexer outputs are applied to inverter cirucits consisting of A7U31A, A7U31D, A7U31E, A7U31F, and transformers T1 and T2. The pulses produced by T1 and T2 secondaries are applied to inverters A7U13A, A7U13B, A7U13D, and A7U13E, which reconstruct the multiplexer inputs for appliection to the data gates. Examples of the RS flip flop outputs are shown in the timing diagram of Figure 6-3 (signals 13-8 and 13-4) and correspond to the following DMM functions and input conditions: VDC function with filter called, 1 range, negative voltage applied to input and remotely controlled. A complete list of waveforms appearing at the output of the RS flip flops is given in the troubleshooting section. (See Figure 6-9.) Waveforms are labeled according to circuit location (e.g., 13-4 means I.C. U13 pin 4).

6-17. DIGITS COUNTER. The digits counter consists of J-K flip flops A6U26A, A6U26B, A6U25A and A6U25B. The input flip flop, A6U25A is toggled by positive pulses, which are transferred through the guard by A7U32C and transformer T3. The counter produces a 4-bit binary output that is entered into the memory via the data gates. The counter is reset at the beginning of each sub-period of the measurement cycle by the $\overline{F}$ signal. The W, Y, and Z counter outputs are also applied to NAND gate A6U22A, which stops the counter at a count of "11" and generates a high at the input of flip flop A6U21B. If another pulse appears at the secondary of T3, it is indicative of "12" in the first decade (i.e., instrument overload). The 12th pulse toggles flip flop A6U21B to produce an overload indication at the DOU output, AP20-13.

6-18. DATA GATES. The data gates consist of NAND gates A7U22C, A7U23A through U23C, and A7U24A through U24D. The gates are controlled by the F, $\overline{F}$, S, and $\overline{S}$ signals so that the 10 bits of function, range, and polarity data and 20 bits of numerical data are presented to

<table>
<tr><th>LOGIC SYMBOL</th><th>NAME</th><th>DESCRIPTION</th></tr>
<tr><td> 
</td><td>J-K Flip Flop</td><td>Operation of the J-K flip flop is shown by the following truth tables. Note that "S" and "R" inputs are dominant over "J" and "K" inputs.

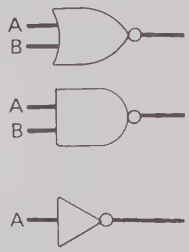
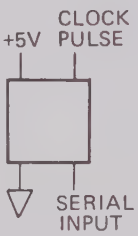
SYNCHRONOUS INPUTS
<table>
<tr><th>J</th><th>K</th><th>Q_{n+1}</th></tr>
<tr><td>0</td><td>0</td><td>Q_n</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>$\overline{Q}_n$</td></tr>
</table>
ASYNCHRONOUS INPUTS
<table>
<tr><th>S</th><th>R</th><th>Q</th><th>$\overline{Q}$</th></tr>
<tr><td>0</td><td>0</td><td colspan="2">Undefined</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0 Set</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1 Reset</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">Normal Condition</td></tr>
</table></td></tr>
<tr><td> 
</td><td>NOR Gate
NAND Gate
Inverter</td><td>The following table shows gate and inverter operation. Although only two-input gates are shown, operation is identical for gates having additional inputs.
<table>
<tr><th>A</th><th>B</th><th>NOR</th><th>NAND</th><th>INVERTER</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
</table></td></tr>
<tr><td> 
</td><td>Shift Register</td><td>Four 8-bit, serial-in parallel-out shift registers are used. A logical "1" at the input enters a logical "1" into the register.</td></tr>
</table>

Figure 6-2. EXPLANATION OF LOGIC SYMBOLOGY USED IN DOU

the shift register memory at the proper times. These data bits are loaded in accordance with the load sequence (see Figure 6-4) and are steered by the data gates.

6-19. RANDOM ACCESS MEMORY. The DOU memory is composed of shift registers A7U10, A7U12, A7U14 and A7U16. Data is loaded serially into the shift registers. The loading sequence is controlled by clock pulses which are produced by gates A7U15A through U15D, gate A7U19B and associated circuitry. Steering signals, S and $\overline{S}$, together with the loading signal, F, develop loading pulses as shown in Figure 6-3. NAND gate A7U19B, inverter A7U13C, and associated circuitry delay the F signal for approximately 10 microseconds so that all data present at the shift register inputs will be stabilized before clocking occurs.

6-20. CONTROL. F and $\overline{F}$ signals are produced by an RS flip flop consisting of NOR gates A7U19A, A7U19C and associated circuitry. The trigger for the flip flop is developed by inverters A7U31B and C, A7U32A, B, and E, and transformer T4. The F and $\overline{F}$ signals are conditioned by the $\overline{F}$, M, and $\overline{ZERO}$ signals so that the F and $\overline{F}$ signals occur only during periods A through $\overline{E}$ of the DMM measurement cycle. The steering flip flop is triggered by the F signal and produces S and $\overline{S}$ signals.

6-21. The $\overline{S}$ output of the steering flip flop is applied to transistor A6Q9 and associated components, which comprise a rechargeable one-shot. This circuit is responsible for initializing control circuit conditions and providing for generation of the M signal. The sequence of operation of the

rechargeable one-shot and associated circuitry is as follows (control timing signals are shown in Figure 6-3):

a. Measurement cycle is initiated.

b. RS flip flop A7U19A, A7U19C is set to "1" condition (pin 2 of 19A high).

c. Flip flop A6U20B, C is reset by $\overline{F}$.

d. Overload flip flop A6U21B is reset by a measurement inclusion signal generated at pin 8 of flip flop A6U20B, C.

e. Measure/store flip flop (A6U20A, D) is set by overload reset signal (signal No. 21-10).

f. Gate A6U17A is inhibited, thereby inhibiting all output buffer gates.

g. The steering flip flop is toggled (Middle of "A" period) and capacitor A6C14 begins to charge toward +5V.

h. The steering flip flop is again toggled (Middle of "B" period) and capacitor A6C14 is quickly discharged to 0.9V.

i. Steps (f) and (g) repeat for "C", "D", and "E" periods.

j. Following "E" period, A6C14 continues to charge until A6Q9 is turned on.

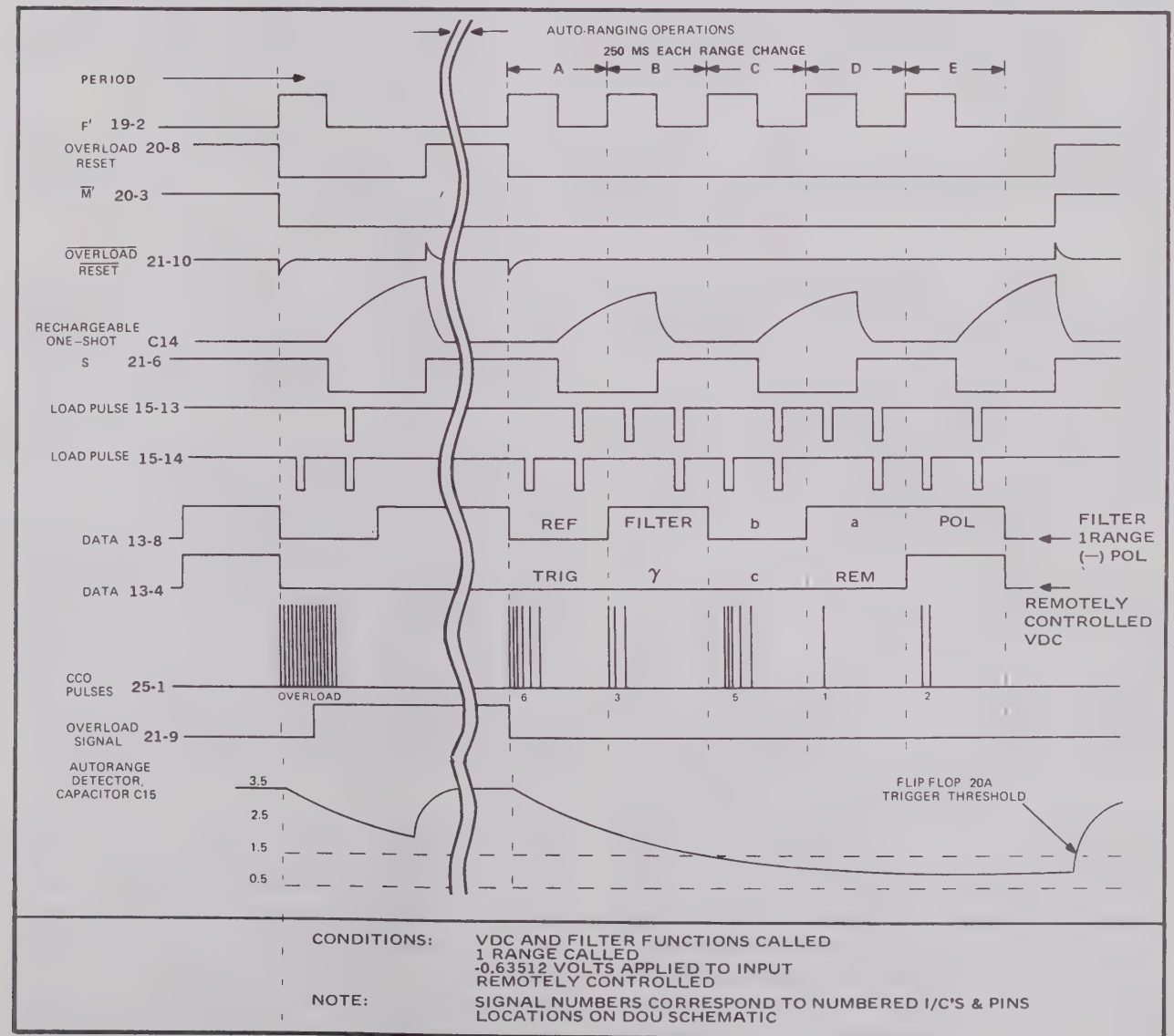
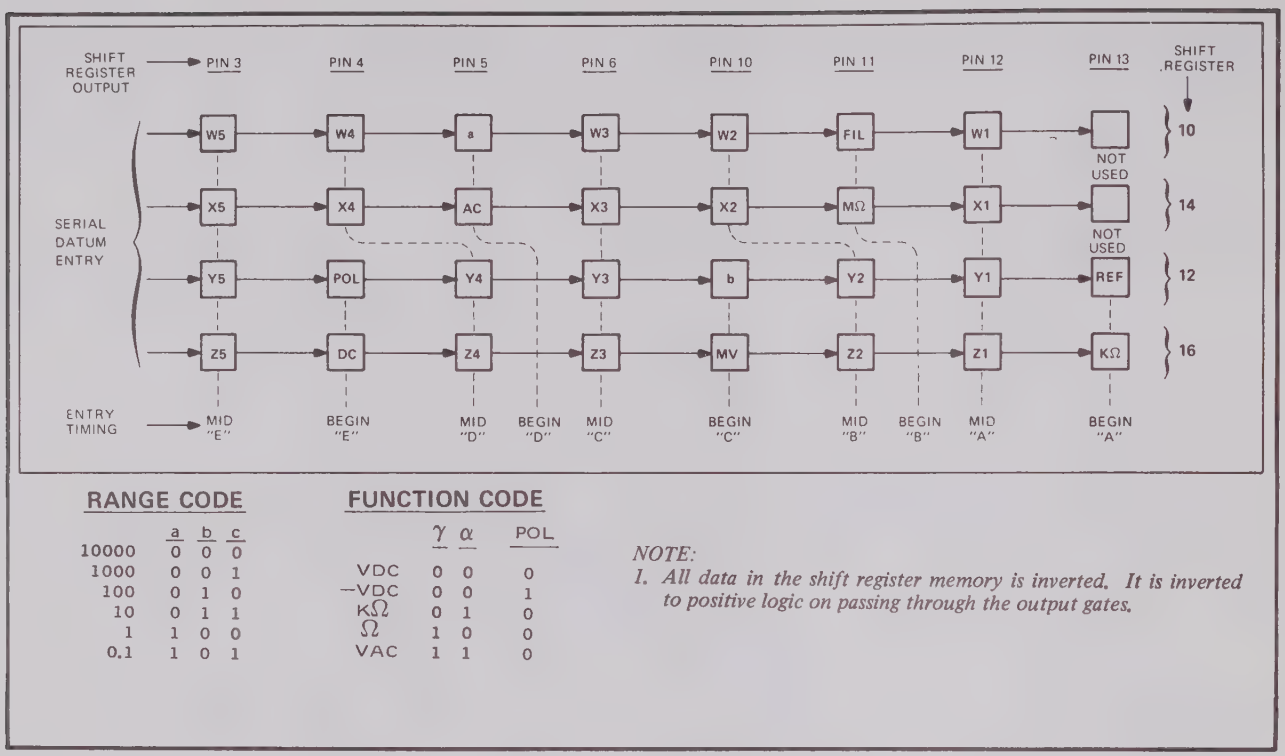


Figure 6-3. DOU TIMING DIAGRAM



RANGE CODE

	a	b	c
10000	0	0	0
1000	0	0	1
100	0	1	0
10	0	1	1
1	1	0	0
0.1	1	0	1

FUNCTION CODE

	γ	α	POL
VDC	0	0	0
–VDC	0	0	1
KΩ	0	1	0
Ω	1	0	0
VAC	1	1	0

NOTE:
1. All data in the shift register memory is inverted. It is inverted to positive logic on passing through the output gates.

Figure 6-4. SHIFT REGISTER LOAD SEQUENCE

k. A6Q8 then turns on and sets the overload reset flip flop A6U20B, C and the steering flip flop (A6U21A).

l. The measure/store flip flop is reset by a negative trigger developed in the circuit of A6Q7.

m. The output buffer gates are enabled and the data becomes available.

6-22. In addition to providing a pseudo measure/store signal, the circuit of flip flop A6U20A, D and transistor A6Q7 also function as an autorange detector. Control signal timing under autorange conditions is shown in Figure 6-5. If the decision to autorange is made (middle of "A" period), the DMM logic places the DOU in storage mode. This locks out the $\overline{F}$ signal in the DOU control circuit and, consequently, no pulses are produced in T4 secondary, excepting the first. With no F signal to toggle flip flop A6U21B the rechargeable one-shot times out and sets the overload reset flip flop to the "1" condition. The resulting signal (signal 21-9) is applied as a reset pulse to A6Q7; however, because capacitor A6C15 has not had time to discharge sufficiently, the trigger threshold of flip flop A6U20A, D is not reached and the flip flop remains in its previous state. Thus, the output buffer gates are inhibited during the autorange operation. If the instrument had not autoranged, A6C14 would have acquired sufficient charge during the measurement cycle to enable flip flop A6U20A, D to be triggered, as shown in the timing diagram of Figure 6-3.

6-23. The programmed one-shot consists of NOR gates A6U18A, C, transistors A6Q3 through A6Q6, capacitor A6C9, and associated programming resistors. In its stable state, gate A6U18C output is high and gate A6U18A output is low. Assume that an external trigger is applied to A6P20-3. The trigger enable gate A6U18B, thereby triggering the DMM to initiate a measurement cycle. The trigger also enables gate A6U18C, and the POS then switches to its unstable state. When the POS switches states, the output of gate A6U18D goes low, resulting in gates A6U17A being inhibited. Inhibiting gate A6U17A causes all of the output data gates to be inhibited.

6-24. The timeout of POS delay is initiated as soon as the circuit is triggered, i.e., when the POS is triggered, switch A6Q3 is turned off and A6C9 begins to charge through the programming network to zero volts. Delay time is controlled by the memory, which selects resistor A6R22, R42, R45, R46, R47, R48, R52, R53, R54, R56, R57, depending on the selected DMM function. When A6C9 has accumulated sufficient charge, transistors A6Q4

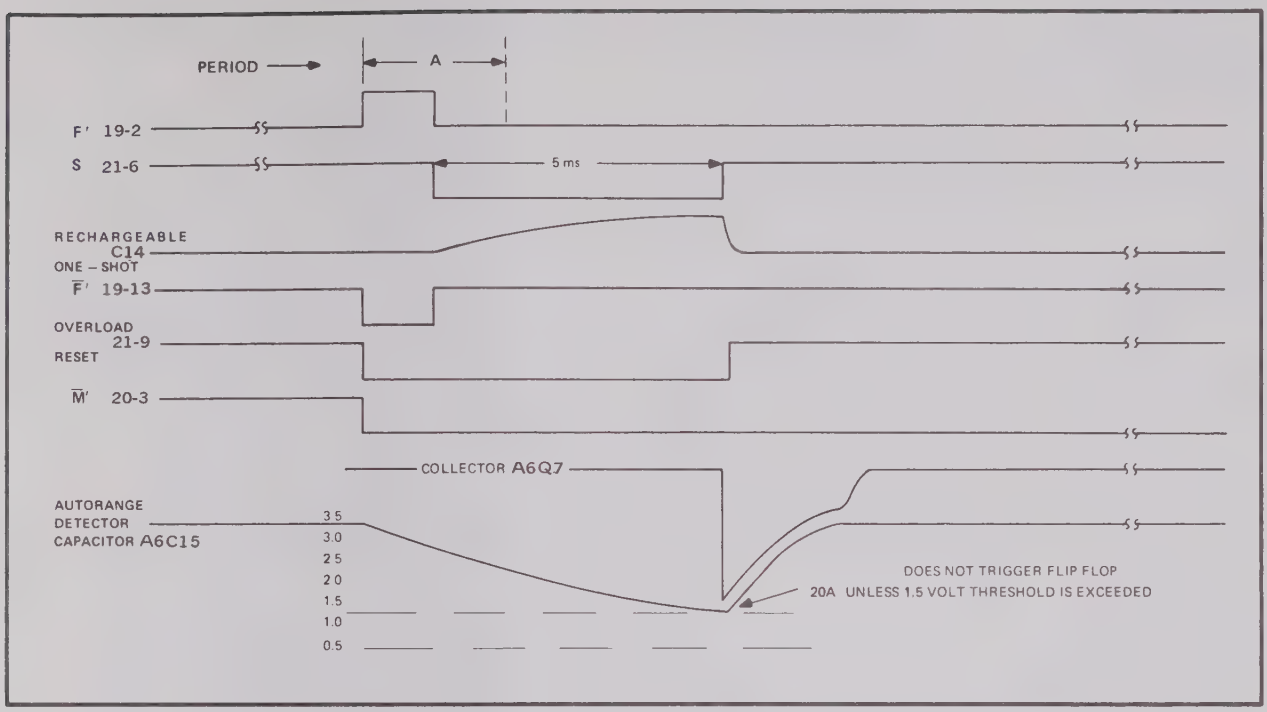


Figure 6-5. CONTROL SIGNAL TIMING DURING AUTORANGE

and A6Q5, connected to operate like an SCR, turn on, applying a positive pulse to the input of gate A6U18A through capacitor A6C24. The POS switches back to its stable state and retriggers the DMM for a final measurement.

6-25. The POS is automatically retriggered if the DMM autoranges as a result of the final measurement. For example, if a step voltage were applied to the DMM in MVDC mode, the DMM logic might not make an autorange decision before the measurement caused by POS timeout. If this occurs, NOR gate A6U18B goes high, retriggering the POS and initiating a second delay. All autorange operations that are to occur do so at this time. Termination of the second POS delay causes yet another measurement. All settling times having been considered at this time, this measurement is the last; and upon completion 30 milliseconds later, outputs are turned on and data becomes available.

6-26. In VDC mode without the FILTER function called, transistor A6Q13 is enabled. This programs the POS for fastest timeout and clamps pin 4 of gate A6U18B so that the DMM will not be retriggered by POS timeout.

6-27. +5 VOLT LOGIC SUPPLY. The +5 volt dc logic supply is operated from a full-wave bridge rectifier and filter consisting of diodes A6CR19 through A6CR22 and capacitors A6C25 through C28. The series regulator is comprised of zener reference A6CR23, voltage amplifier A6Q10, driver A6Q11, and series pass transistor A6Q12. This supply has sufficient reserve to power the Remote Control Unit (Option 8375A–03), if installed. The +5 volts is connected to A6P6-1 and returned to A6P6-4 for that purpose.

6-28. MAINTENANCE

6-29. Introduction

6-30. This section contains maintenance information for the DOU. Factory service information and general instructions regarding instrument access and cleaning are located in Section 4 of the manual.

6-31. Test Equipment

6-32. The equipment recommended for performance testing, troubleshooting, and calibration of the DOU is listed in Figure 6-6. If the recommended equipment is not available, equivalent or better instruments may be substituted.

EQUIPMENT NOMENCLATURE	RECOMMENDED EQUIPMENT
OSCILLOSCOPE	TEKTRONIX MODEL 547
OSCILLOSCOPE PLUG-IN	TEKTRONIX MODEL 1A1
OSCILLOSCOPE PROBES	TEKTRONIX MODEL P6010
DC VOLTAGE SOURCE	FLUKE MODEL 343A DC VOLTAGE CALIBRATOR
DC DIFFERENTIAL VOLTMETER	FLUKE MODEL 885A
DOU OUTPUT READER/DISPLAY SYSTEM (CUSTOMER SUPPLIED)	

Figure 6-6. TEST AND CALIBRATION EQUIPMENT.

6-33. Performance Tests

6-34. The following performance tests exercise the DOU to determine if the unit is working properly. The tests should be conducted before maintenance or calibration is attempted. The tests are also suited to receiving inspection of new units. Performance tests should be conducted under the following environmental conditions: ambient temperature 23°C ±5°C, relative humidity less than 70%. In case of trouble, analysis of the test results, with reference to the troubleshooting, should help to locate the trouble.

6-35. LOGIC VOLTAGE CHECK

a. Connect a dc voltmeter between A6P6-1 (+) and A6P6-4 (–) of DOU NO: 2.

b. If necessary, adjust potentiometer A6R38 for 5.05 ±0.05 volts dc indication on the voltmeter.

6-36. DIGITS REGISTRATION

a. Set Model 8375A controls as follows:

FUNCTION	VDC
RANGE	10
SAMPLE RATE	EXT (sample as required)

b. Connect a +1.1111 volt dc test signal to the INPUT terminals.

c. Command the DMM to take a reading. The DOU output and the front panel display should indicate DC +1.1111.

d. Repeat steps (b) and (c) for test signal inputs of +2.2222, +4.4444, and +8.8888 volts dc. The DOU output and front panel display should correspond.

6-37. OVERLOAD INDICATOR

a. Set Model 8375A controls as follows:

FUNCTION	VDC
RANGE	10
SAMPLE RATE	EXT (sample as required)

b. Connect a +20 volt dc test signal to the INPUT terminals.

c. Command the DMM to take a reading by applying one external sample pulse. The DOU outputs and front panel display should indicate DC +11.9999 and OVERload.

6-38. FUNCTION REGISTRATION

a. Set Model 8375A controls as follows:

FUNCTION	VAC
RANGE	100
SAMPLE RATE	EXT

b. Short the INPUT terminals.

c. Apply one external sample pulse. The DOU outputs and front panel display should indicate VAC and a readout of 00.000 ±2 digits.

d. Repeat steps (a) through (c) for each of the following DMM functions. The DOU output and front panel display should be as indicated.

FUNCTION	DOU OUTPUT/DMM DISPLAY
KΩ	KΩ, 00.000
10 Ω	Ω, 0.0000
VDC, FILT, EXT. REF.	VDC, 00.000 FILT, EXT. REF.

6-39. OUTPUT GATES

a. Set Model 8375A controls as follows:

FUNCTION	VDC
RANGE	10
SAMPLE	EXT

b. Connect a –0.0010 volt dc test signal to the INPUT terminals.

c. Command the DMM to take a reading. The DOU output and DMM display should indicate DC – 0.0010 ±2 digits.

d. Short all of the following DOU output gate terminals to ground A6P6-4. The DOU output should be as indicated.

GATE TERMINALS (PIN AND CONNECTOR)	DOU OUTPUT
A6P20-26	DC, FILT, EXT.
A6P20-22	REF, AC, Ω, KΩ,
A6P20-17	REMOTE CONTROL,
A7P21-36	OVERLOAD, EXT.
A7P21-35	TRIG.
A7P21-19	and readout of 1555.55
A7P21-13	
A7P21-1	
A7P21-25	
A7P21-5	

6-40. PROGRAMMED ONE SHOT.

a. Set the Model 8375A controls as follows:

FUNCTION	VDC, FILTERED
RANGE	100
SAMPLE RATE	EXT (rate should be approximately 1 sample/5 seconds).

b. Connect oscilloscope to ready line, A6P20-8 of DOU output connector. Command instrument to sample. Delay length should be 523 ±20 milliseconds.

c. Set the function and range controls as follows. The delay lengths should be as indicated.

	POS Operative	Function Calls	Range Call	Observe Length (m5)
a.	Yes	VDC, Filt	100	523 ±20 ms
b.	”	VAC, Filt	”	523 ±42 ms
c.	”	Ω, Filt	”	523 ±42 ms
d.	”	KΩ, Filt	”	523 ±42 ms
e.	No	KΩ, Filt	”	31 ±2 ms
f.	Yes	VDC	1	123 ±10 ms
g.	”	VDC	100	54 ±3 ms
h.	”	VAC	”	123 ±10 ms
i.	”	Ω	”	123 ±10 ms
j.	”	KΩ	”	73 ±6 ms

6-41. Calibration

6-42. Calibration of the DOU consists only of adjustments of the +5 volt dc logic supply. The adjustment procedure is located in paragraph 6-35.

6-43. Troubleshooting

6-44. This section contains information selected to aid in troubleshooting the DOU. Before attempting to troubleshoot the unit, however, it should be verified that the trouble is actually in the DOU and is not caused by faulty external equipments or improper control settings. For this reason, the performance tests (paragraph 6-33) are suggested as a first step in troubleshooting. The performance tests may also help to localize the trouble to a particular section of the instrument. If the performance tests fail to localize the trouble, the following information may be helpful.

6-45. Trouble analysis of the Data C ıtput Unit is most efficiently performed by a systematic sequence of checks through the unit beginning at the malfunctioning output or outputs and working progressively backwards. As familiarity with the unit increases the operator will discover he can truncate the process omitting obviously irrelevant steps.

6-46. In any analysis, certain decisions and/or conclusions must be made. Consult Figure 6-7 for the suggested decision sequence. Figure 6-8 is a table of decision aids, which should help to determine how to make the decisions.

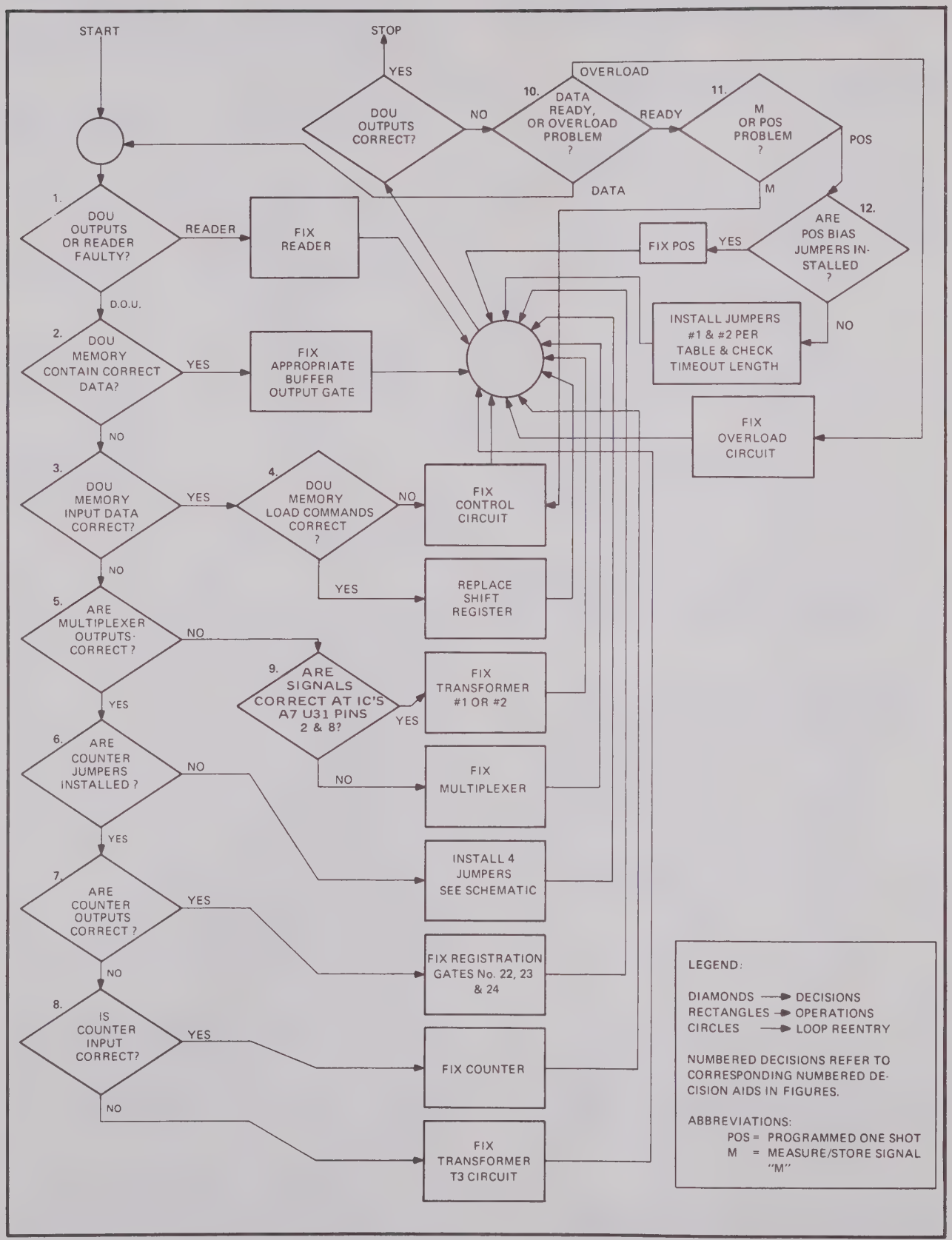


Figure 6-7. DECISION FLOW CHART DOU TROUBLE SHOOTING

1. **DOU OUTPUTS OR READER FAULTY?** This decision must be based upon a point-by-point measurement of DOU outputs at points of origin. Many short cuts are available, depending upon the nature of the reader.

EXAMPLE No. 1. Suppose all decades except the third are producing correct numbers. The third decade generates the following table:

	MODEL 8375A PANEL	READER PANEL	CONSIDER
All possible combinations shown for illustration	00000	00400	An open in the cable from DOU to reader (probably A7P21-17 DOU connector.) This is the "4" line of the 1-2-4-8 four line BCD code.
	11111	11511	
	22222	22622	
	33333	33733	
	44444	44444	
	55555	55555	
	66666	66666	
	77777	77777	
	88888	88288	
	99999	99399	

EXAMPLE No. 2.

	MODEL 8375A PANEL	READER PANEL	CONSIDER
Only these combinations need to be considered for trouble analysis.	00000	08000	An open DOU–to–reader (probably A7P21-21 DOU output connector).
	11111	19111	
	22222	20222	
	44444	42444	
	88888	88888	

EXAMPLE No. 3. Reader panel is 155555, DC+, AC, KΩ, Ω, EXT. REF., FILT., REM., TRIG., OVER.

The above display remains regardless of Model 8375A PANEL.

CHECK: Pin 32B DOU connector. If not 0 to 0.5Vdc, disconnect reader and measure again. If now 0 to 0.5V, reader is at fault–if not, look for problem in DOU ready circuit.

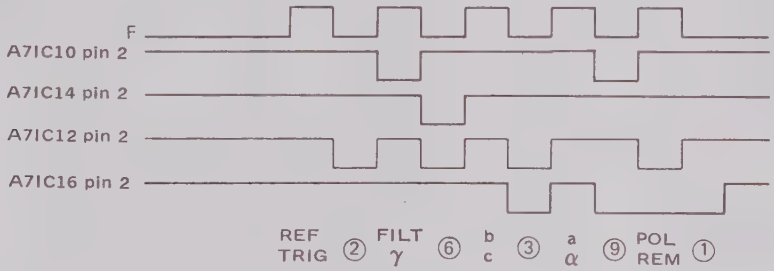
NOTE: The above examples assume a reader with full overranging in each decade. Other overrange patterns will not defeat the analysis if the pattern is known.

2. **DOU MEMORY CONTAIN CORRECT DATA?** It is assumed here that data outputs were determined to be faulty. This is a static test. Set Model 8375A stimulous to produce the trouble analysis information desired. Command to sample once only. Using a vtvm, check data in shift register (DOU memory) 10, 12, 14, and 16. Use chart of Figure 6-4 for location of data. All data in this memory is inverted phase, (e.g., 6 would normally be represented as 0110, but it is in the memory as 1001). The chart of Figure 6-4 will prove to be a valuable troubleshooting tool for several areas of the DOU circuitry. If data in the memory is correct, the problem must be in an output buffer gate or in the first decade binary-to-BCD converter, IC11. If not, it must be determined whether a shift register is faulty. This is proven by determination that serial data input signals are correct and that load signals are correct.

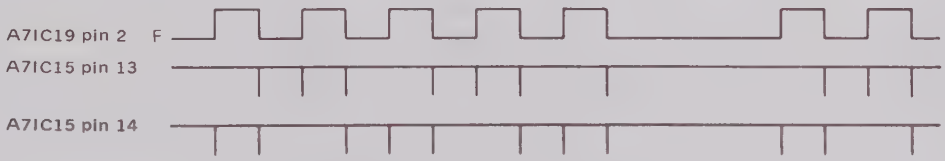
Figure 6-8. DECISION AIDS (Sheet 1 of 3)

3. **DOU MEMORY INPUT DATA CORRECT?** Unfortunately this must be a dynamic test and for the uninitiated user may require observation of a properly operating unit. Set stimulous equipment (Model 8375A and input source) for desired trouble analysis information. Set internal sample command potentiometer on Model 8375A panel to EXT position and externally trigger the instrument. The rate should be 25 pps for good oscilloscope displays. Ignore reader display as it is unimportant at this point. Sync the scope with F signal and observe shift register data inputs. Refer to waveshapes at points 13-8 and 13-4 and refer to the waveshape index, Figure 6-9. These waveforms are multiplexed with numerical data from the counter and inverted by registration gates IC22, IC23, and IC24 on A7 PCB. Study the schematic and Figures 6-4, 6-9 to visualize what appearance these signals should have for various combinations of data. A table is not given as there would be 256^4 possible variations. It is much easier to determine what a particular combination should produce and will require only a few seconds for an experienced operator using Figure 6-5. Again, remember that all data in memory is inverted phase.

EXAMPLE: –.026391 VDC, FILT, REM. CONT.



4. **DOU LOAD COMMANDS CORRECT?** Refer to the following load signals. Use the same setup as in part 3 of this figure. A dual-trace scope is useful.



LOAD SIGNALS

If the load commands are correct, then something may be wrong with the operation of one of the shift registers. If replacement does not solve the problem, one of the shift register output may be shorted.

5. **ARE MULTIPLEXER OUTPUTS CORRECT?** Use the same setup as in part 3 of this figure. Figure 6-9 gives a table which illustrates all possible waveforms at IC13 pin 4 and IC13 pin 8 of A7 Assembly respectively. If the waveforms are correct, registration gates A7IC24 and A7IC24 may be faulty.

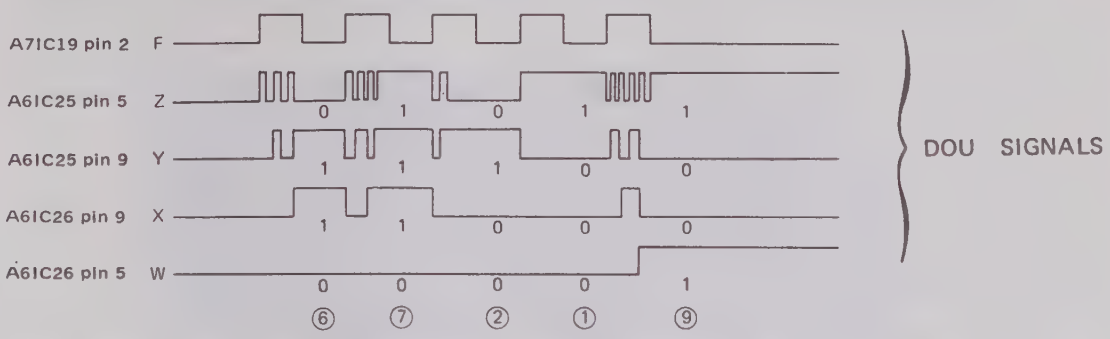
6. **ARE COUNTER JUMPERS INSTALLED?** With reader connected, check continuity between the following points on Data Output Unit No. 2 (A6):

P20-9 & P20-25	A6
P20-5 & P20-21	DOU Output
P20-7 & P20-23	Connector
P20-11 & P20-19	

Figure 6-8. DECISION AIDS (Sheet 2 of 3)

7. **ARE COUNTER OUTPUTS CORRECT?** Use the same setup as in part 3 of this figure. Consider counter outputs only during second half of each subperiod as follows:

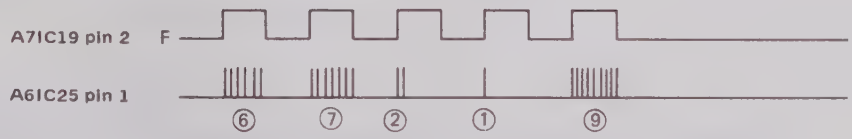
EXAMPLE: .67219 on Model 8375A panel.



Again, correct counter operation is indicative of a problem in registration gates IC22, IC23 and IC24.

8. **IS COUNTER INPUT CORRECT?** Use same setup as in part 3 of this figure. The same example as in part 7 is used.

EXAMPLE:



Correct input but incorrect outputs are indicative of counter malfunction.

9. **ARE SIGNALS CORRECT AT A7IC31 pins 2 & 8?** This DOU circuit is inside the guard. Therefore, the scope must be synced to a signal inside the guard. Use $\overline{\text{zero}}$ signal. If multiplexer outputs (test portion of part 5) are incorrect but observations of part 9 are normal, the transformer circuits of T1 or T2 may be faulty. Signals at pins 2 and 8 of A7U31 should have waveforms like Figure 6-9. If not, multiplexers may be at fault or wires may be broken between DOU input terminals and the connector inside the guard box.

10. **DATA, READY OR OVERLOAD PROBLEM?** This is a static test. Command Model 8375A to sample only once, with SAMPLE RATE control on front panel in external position, then observe. If numerals, range, polarity, or function data is faulty, it will be observable on the reader (monitor). If the reader is either blank of displaying 1555.55 VDC+, FILT, REM., AC, KΩ, Ω, or EX. REF., OVER, TRIG. then the ready line is probably high. The overload display should coincide with a numeral display of 119999 and will be visible on the reader.

11. **M OR POS PROBLEM?** Command to sample only once, with SAMPLE RATE control in external position. Check A6U18 pin 10 for 0 to 0.5V (POS) and A6U17 pin 2 for 3.5 to 4.5V ($\overline{\text{M}}$ signal). If M is low it is likely that POS will be high, but the cause will be $\overline{\text{M}}$, which comes from the control circuit. If $\overline{\text{M}}$ is normal but POS is high, the programmed one-shot is faulty.

12. **ARE POS BIAS JUMPERS INSTALLED?** Visually check to insure that jumpers No. 1 and 2 are installed or jumpers No. 1 or No. 2 and A6R50 in accordance with delay length table. (This is a factory installation procedure and jumper installation need only be verified as indicated.)

Figure 6-8. DECISION AIDS (Sheet 3 of 3)

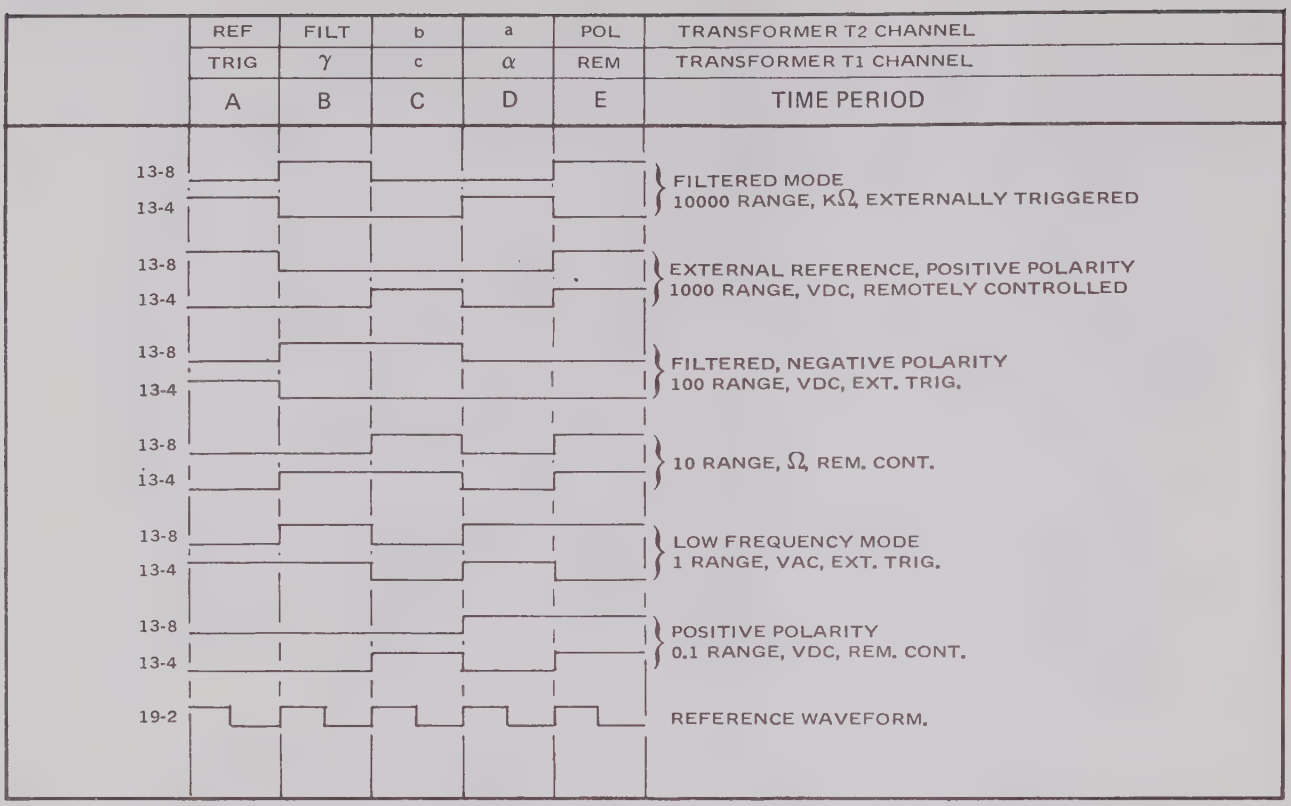


Figure 6-9. EXAMPLE WAVEFORMS FOR TROUBLESHOOTING

6-47. LIST OF REPLACEABLE PARTS

6-48. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5, paragraphs 5-1 through 5-8.

A6, DATA OUTPUT NO. 2 PCB ASSEMBLY

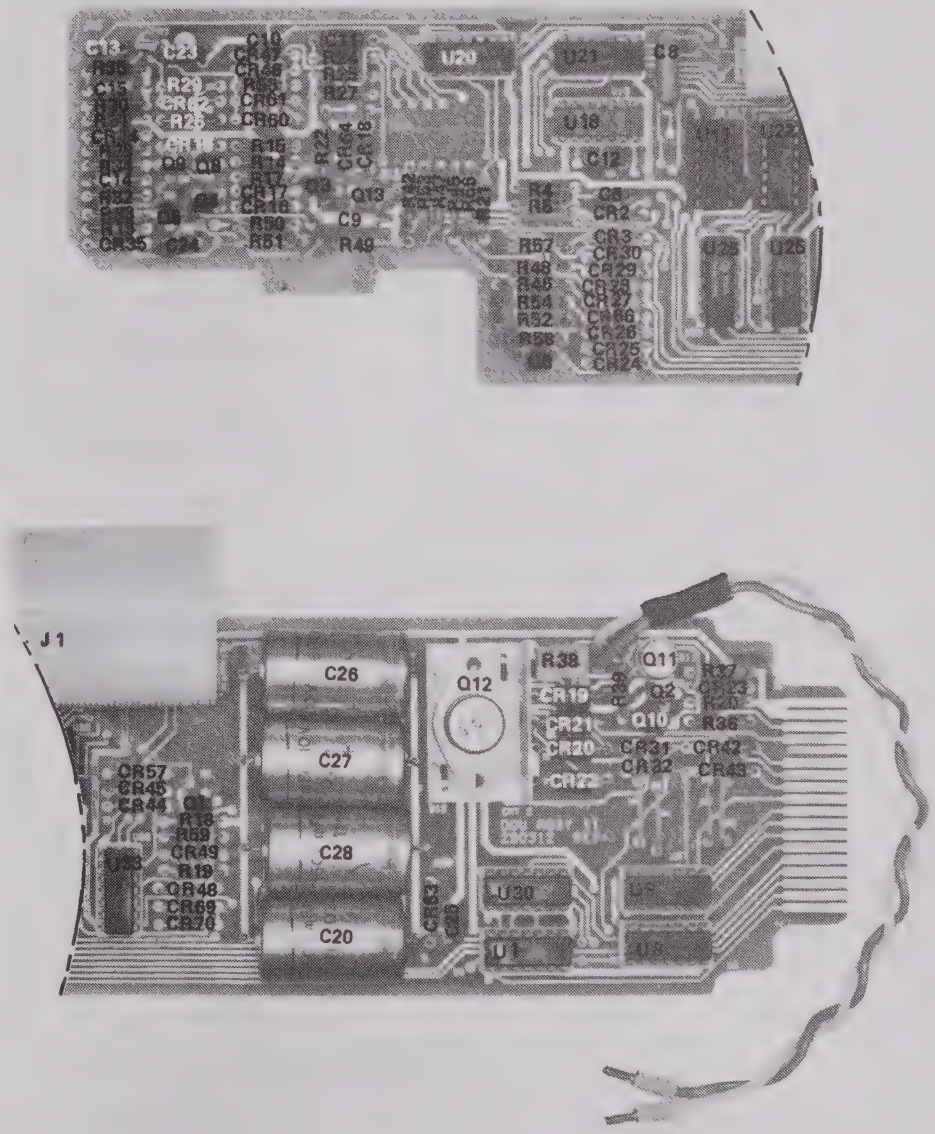


Figure 6-10. DATA OUTPUT NO. 2 PCB ASSEMBLY

A6, DATA OUTPUT NO. 2 PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**DATA OUTPUT NO. 2 PCB ASSEMBLY (–03 Option) Figure 6-10**	1	REF		
C6,C12, C24,C25, C31	Cap, cer, 0.0012μf ± 10%, 500V	106732	5		
C8	Cap, plstc, 0.22μf ± 10%, 250V	194803	1		
C9	Cap, Ta, 3.3μf ± 5%, 20V	271230	1		
C10,C13, C30,C32, C33,C35, C36,C40	Cap, cer, 0.01μf ± 20%, 100V	149153	8		
C11	Cap, Ta, 2.2μf ± 10%, 20V	160226	1		
C14	Cap, Ta, .33μf ± 5%, 20V	271338	1		
C15	Cap, Ta, 0.68μf ± 10%, 35V	182790	1		
C20,C26, C27,C28	Cap, elect, 1600μf +50/–10%, 10V	272732	1		
C23,C29	Cap, cer, 0.025μf ± 2%, 100V	168435	2		
CR2,CR14, CR18,CR31, CR32,CR42 thru CR49, CR60 thru CR63,CR71 CR72	Diodew, germanium, 80 mA, 100 piv	149187	19		
CR3,CR15 CR16,CR17, CR24 thru CR30,CR35 CR57,CR64, CR66,CR69, CR70, CR100	Diode, silicon, 150 mA	203323	18		
CR19 thru CR22	Diode, silicon, 1 amp, 100 piv	116111	4		
CR23	Diode, zener, 4.3V, 20 mA	180455	1		
J1	Connector, PCB to cable, 34 contact	295337	1		
Q1,Q2,Q6, Q7,Q8	Tstr, silicon, NPN	218396	5		
	1 Order by Model and Option No. (8375A–03 Option)				

A6, DATA OUTPUT NO. 2 PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q3,Q9,Q13	Tstr, silicon, PNP	195974	3		
Q4	Tstr, semicon, silicon NPN	218081	1		
Q5	Tstr, silicon, PNP	229898	1		
Q10	Tstr, silicon, NPN	168708	1		
Q11	Tstr, silicon, NPN	150359	1		
Q12	Tstr, silicon, NPN	288381	1		
R4,R5,R30 R31,R61 R62,R63, R64	Res, comp, 4.7k ± 5%, 1/4w	148072	8		
R14,R15	Res, comp, 2.7k ± 5%, 1/4w	170720	2		
R16	Res, comp, 47k ± 5%, 1/4w	148163	1		
R17	Res, comp, 6.8k ± 5%, 1/4w	148098	1		
R18,R59	Res, comp, 680Ω ± 5%, 1/4w	148007	2		
R19,R20, R21,R25, R26,R27	Res, comp, 10k ± 5%, 1/4w	148106	6		
R22	Res, fxd, met flm, 1.62k ± 1%, 1/8w	283697	1		
R24,R55	Res, comp, 1k ± 5%, 1/4w	148023	2		
R28	Res, comp, 220Ω ± 5%, 1/4w	147959	1		
R29	Res, comp, 1.8k ± 5%, 1/4w	175042	1		
R32	Res, comp, 2.2k ± 5%, 1/4w	148049	1		
R33	Res, comp, 3.3k ± 5%, 1/4w	148056	1		
R34	Res, comp, 27k ± 5%, 1/4w	148114	1		
R35	Res, comp, 15k ± 5%, 1/4w	148148	1		
R36	Res, comp, 3.9k ± 5%, 1/4w	148064	1		
R37	Res, comp, 5.6k ± 5%, 1/4w	148080	1		
R38	Res, var, cer met, 500Ω ± 10%, 1w	291120	1		
R39	Res, met flm, 182Ω ± 1%, 1/8w	200030	1		
R42	Res, comp, 150k ± 5%, 1/4w	182212	1		
R45,R47, R53,R56	Res, fxd, met flm, 105k ± 1%, 1/8w	291294	4		
R46	Res, met flm, 20.5k ± 1%, 1/4w	261669	1		

A6, DATA OUTPUT NO. 2 PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R48,R54	Res, met flm, 20.5k ± 1%, 1/8w	261669	2		
R49	Res, fxd, met flm, 274k ± 1%, 1/8w	237297	1		
R50	Res, comp, factory selected		1		
R51	Res, met flm, 140k ± 1%, 1/8w	233148	1		
R52	Res, met flm 6.81k ± 1%, 1/8w	268417	1		
R57	Res, met flm, 1.87k ± 1%, 1/8w	267229	1		
R58	Res, comp, 56k ± 5%, 1/4w	170738	1		
U1	IC, DTL, Hex Inverter	268367	1		
U8,U9 U30,U33	IC, DTL, Quad 2-Input Nand Gate	268375	4		
U17	IC, DTL, Quad 2-Input Nand Power Gate	288597	1		
U18	IC, TTL, Quad 2-Input Nor Gate	268540	1		
U20	IC, TTL, Quad 2-Input Nand Gate	292953	1		
U21,U25, U26	IC, DTL, Dual JK Flip-Flop	288811	3		
U22	IC, DTL, Triple 3-Input Nand Gate	266312	1		
	Socket, IC, 14 contact	276527	10		
	Socket, IC, 14 contact	291542	2		

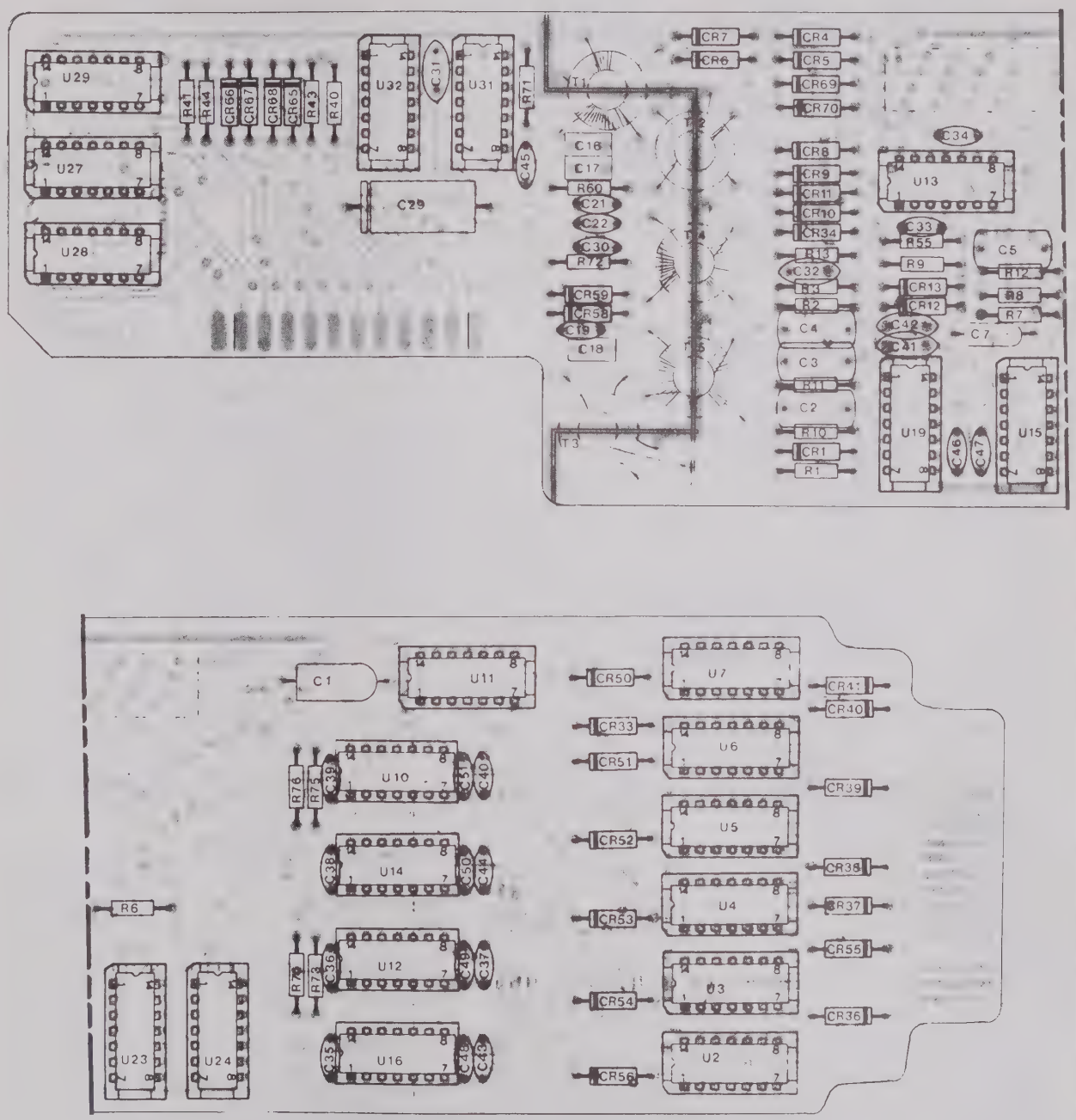


Figure 6-11. DATA OUTPUT NO. 1 PCB ASSEMBLY

A7, DATA OUTPUT NO. 1 PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A7	**DATA OUTPUT NO. 1 PCB ASSEMBLY (–03 Option) Figure 6-11**	1	REF		
C1	Cap, elect, 200μf +50/–10%, 10V	236935	2		
C2,C4	Cap, plstc, 0.1μf ± 10%, 250V	161992	2		
C3,C5	Cap, plstc, 0.027μf ± 10%, 250V	267120	2		
C6,C8 thru C15,C20, C23 thru C28	Used on D.O.U. No. 2				
C7	Cap, Ta, 0.68μf ± 10%, 35V	182790	1		
C16,C17,C18	Cap, cer, 0.22 μf ± 20%, 50V	309849	3		
C19,C21, C22,C30, C33,C34, C37,C40, C43 thru C51	Cap, cer, 0.01μf ± 20%, 100V	149153	17		
C31	Cap, cer, .005μf ± 20%, 50V	175232	1		
C32,C41, C42	Cap, cer, .025μf ± 20%, 50V	168435	3		
C35 thru C39	Cap, cer, .0012μf ± 10%, 500V	106732	4		
CR1,CR4 thru CR13, CR33,CR34 CR36 thru CR41,CR50 thru CR56, CR58,CR59, CR65 thru CR70	Diode, germanium, 80 mA, 100 piv	149187	34		
CR2,CR3, CR14 thru CR32,CR35 CR42 thru CR49,CR57 CR60 thru CR64	Not Used				

1 Order by Model and Option No. (8375A–03 Option)

A7, DATA OUTPUT NO. 1 PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
P22	Connector, PCB to cable, 34 contact	295337	1		
R1,R11	Res, comp, 100Ω ± 5%, 1/4w	147926	2		
R2,R3,R72	Res, comp, 220Ω ± 5%, 1/4w	147959	3		
R4,R5,R14 thru R39, R45 thru R54	Not Used				
R6,R7,R13	Res, comp, 3.9k ± 5%, 1/4w	148064	3		
R8,R40, R41,R43, R44	Res, comp, 470Ω ± 5%, 1/4w	147983	5		
R9,R55	Res, comp, 12k ± 5%, 1/4w	159731	2		
R10	Res, comp, 10k ± 5%, 1/4w	148106	1		
R12	Res, comp, 1k ± 5%, 1/4w	148023	1		
R60,R71	Res, comp, 390Ω ± 5%, 1/4w	147975	2		
R73 thru R76	Res, comp, 27Ω ± 5%, 1/4w	160812	4		
T1 thru T5	Transformer, pulse	275362	5		
U1,U8,U9, U17,U18, U20,U21, U22,U25, U26,U30	Not Used				
U2 thru U7 U11,U24, U27,U28, U29	IC, DTL, Quad 2-Input Nand Gate	268375	11		
U10,U12, U14,U16	IC, TTL, 8-bit Shift Register	272138	4		
U13,U32	IC, DTL, Hex Inverter	268367	2		
U15,U19	IC, TTL, Quad 2-Input Nor Gate	268540	2		
U23	IC, DTL, triple 3-Input Nand Gate	266312	1		
U31	IC, TTL, Hex Inverter	292979	1		
	Socket, IC, 14 contact	276527	17		
	Socket, IC, 14 contact low profile	291542	4		

Option–04
Remote Control Unit

6-1. INTRODUCTION

6-2. The A5 Remote Control Unit (Option–04) enables the Model 8375A to be programmed remotely. The RCU provides the capability of controlling all functions and ranges, with logic interlocking provided to make it impossible to call two or more incompatible functions simultaneously.

6-3. SPECIFICATIONS

6-4. Specifications for the Remote Control Unit are located in Section 1 of the manual.

6-5. INSTALLATION

6-6. The following procedure is to be used to install the A5 Remote Control Unit in the Model 8375A (refer to Section 5, Figure 5-1).

a. Disconnect the power cord from the instrument.

b. Remove the top dust and guard chassis covers.

c. Determine that connector J5, on the A14 Display board, is clear of obstructions and that alignment spacers are inserted between pin pairs J5-1, -2; J5-3, -4 and J5-7, -8; J5-9, -10.

d. Determine that connector slot on rear panel for P19 on Remote Control Unit board is clear of any obstructions.

e. Attach spring to bottom portion of guard bar.

f. Insert P19 into connector slot on rear panel.

g. Insert edge of Remote Control Unit board into card guide on the inner chassis bulkhead.

h. Observe that alignment spacers on J5 line up with slots on the Remote Control Unit card-edge connector.

i. Slide pcb downward until the card-edge connector is fully engaged with J5 on A14 Display board.

j. Attach top guard and chassis covers, connect ac power, and perform receiving inspection test of the Remote Control Unit as described in paragraph 6-27, Performance Test.

6-7. OPERATING INSTRUCTIONS

6-8. Operation of the DMM with the A5 Remote Control Unit installed is covered in Section 2.

6-9. THEORY OF OPERATION

6-10. General

6-11. The RCU functional block diagram is given in Figure 6-1. The input function and range commands are applied to coders and then delivered to a multiplexer. The multiplexer receives sequential address information from a counter and, combined with the range and function codes, applies control information to two isolation pulse transformers. The serial output of these two pulse transformers

is applied to the shift register for conversion back to 8 time slots which are then buffered and decoded and presented for use. For the following discussion refer to Schematic Diagram 8375A-1011, Figure 6-1 and Figure 6-2.

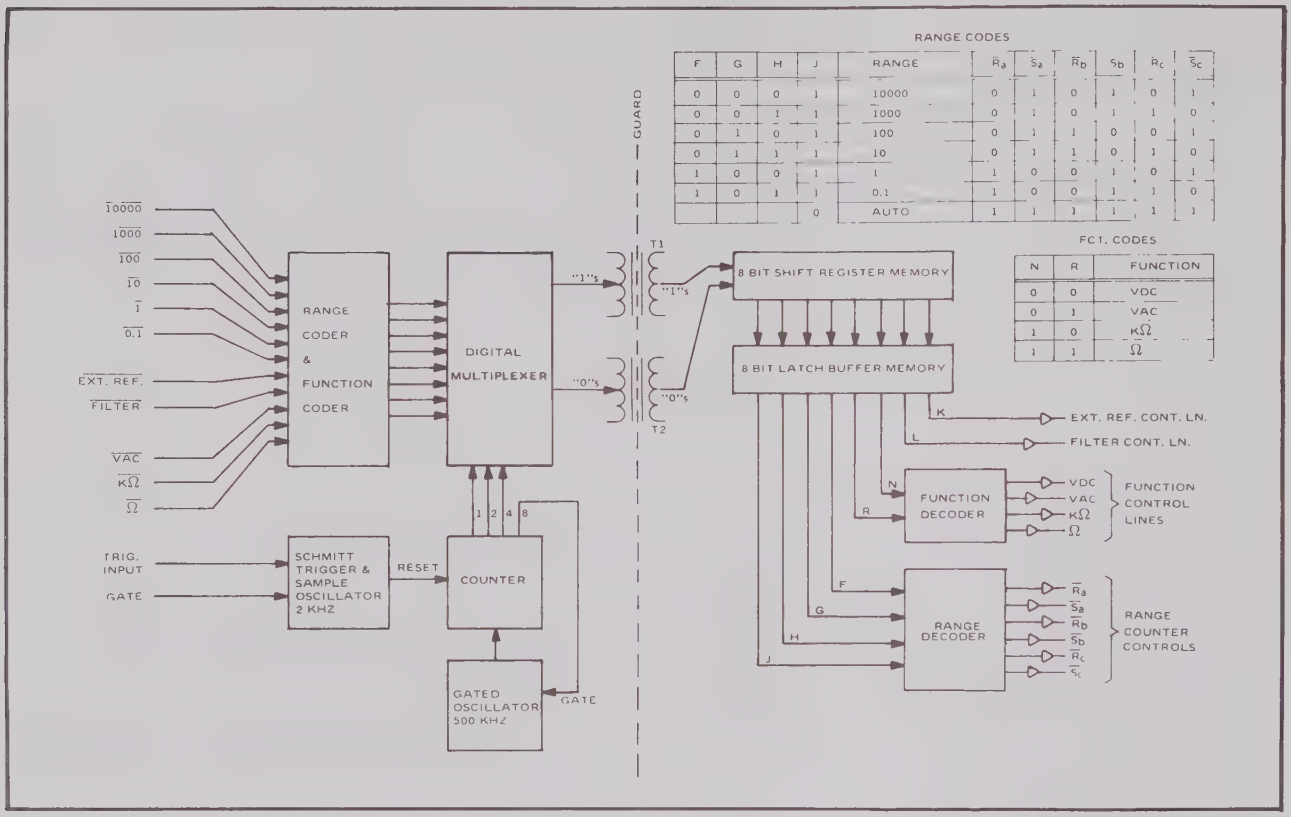


Figure 6-1. 8375A REMOTE CONTROL UNIT BLOCK DIAGRAM

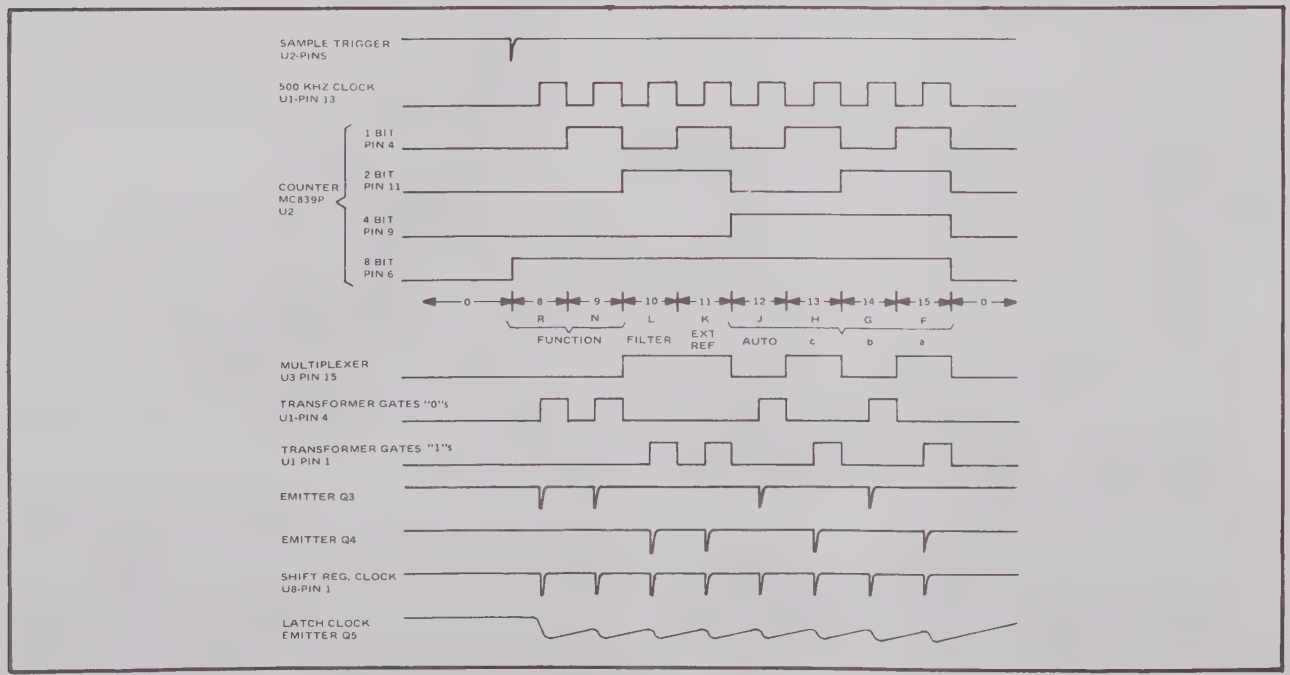


Figure 6-2. REMOTE CONTROL SAMPLE LOAD SEQUENCE

6-12. Circuit Description

6-13. FUNCTION AND RANGE CODERS. The purpose of the function and range coders is to compress the 12 input lines into 8 channels with function/range interlocking. Transistor Q15, inverters U15 A, C, F and diodes CR2, 3, 4, 5, 12, 19 and 20 combined are the function/range interlocking feature which disallows incorrect function and range combinations. Gates U5A, U5B, U6A through U6D present encoded range and function information to the digital multiplexer. Table 6-1 shows Function codes and Table 6-2 shows Range codes.

Table 6-1. FUNCTION CODES

INPUTS			RESULTING COMMAND	INFORMATION CHANNEL	
VAC	KΩ	Ω		N	R
1	1	1	VDC	0	0
0	1	1	VAC	0	1
1	0	1	KΩ	1	0
1	1	0	Ω	1	1

Table 6-2. RANGE CODES

FUNCTION COMMANDS POSSIBLE WITH THESE RANGES	RCU INPUTS						RANGE INFORMATION CHANNEL				OUTPUTS						RESULTING RANGE
	10k	1k	100	10	1	0.1	F	G	H	J	Ra	Sa	Rb	Sb	Rc	Sc	
Ω, KΩ, AC, DC	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	AUTO
Ω, KΩ	0	1	1	1	1	1	0	0	0	1	0	1	0	1	0	1	10k
Ω, KΩ, AC, DC	1	0	1	1	1	1	0	0	1	1	0	1	0	1	1	0	1k
Ω, KΩ, AC, DC	1	1	0	1	1	1	0	1	0	1	0	1	1	0	0	1	100
Ω, AC, DC	1	1	1	0	1	1	0	1	1	1	0	1	1	0	1	0	10
AC, DC	1	1	1	1	0	1	1	0	0	1	1	0	0	1	0	1	1
DC ONLY	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	0	0.1

6-14. COUNTER AND GATED OSCILLATOR. The purpose of the counter and gated oscillator circuitry is to supply sequential address information to the multiplexer in response to the 8 bit set pulses from the Schmitt Trigger and Sample Oscillator Circuitry. The 8 bit set pulses reset the counter to an 8 state (i.e. 1000). The counter U2 then releases the gated oscillator and allows it to oscillate at 500 kHz. Gates UIC and UID, capacitors C1, C2 and resistors R1, R2 are the gated 500 kHz oscillator circuitry. The output of the gated oscillator is applied to the counter U2. When enabled, the oscillator causes the counter to cycle through eight states. (Refer to Table 6-3). As soon as state "0" (i.e. 000) is reached by the counter, the oscillator is disabled by the counter, which in turn stops the counter from further counting. This sequence will not start again until an 8 bit set pulse is received by the counter from the Schmitt Trigger circuitry.

6-15. SCHMITT TRIGGER AND SAMPLE OSCILLATOR. The purpose of the Schmitt Trigger and Sample Oscillator is to set the sample rate of the RCU. Gates U4A through U4D, capacitors C3 and C4, resistors R3, R4, R5 and diodes CR30 and CR31 comprise the Schmitt Trigger and Sample Oscillator circuitry. There are two possible modes of operation for this circuitry: continuous or triggered command mode.

6-16. CONTINUOUS COMMAND MODE. In this mode of operation, P19-33 (EXTERNAL COMMAND ENTRY) and P19-35 (AUTO COMMAND DEFEAT) must be at logic level "1" (+5V dc or open). A "1" command simultaneously present at pin 1 of gate U4A and pin 5 of gate U4B will cause gates U4A, B, C and D to oscillate. The frequency of

Table 6-3. COUNTER SEQUENCE

STATE	COMMENTS
0000	Oscillator is enabled at this point and count sequence begins.
1000	
1001	
1010	
1011	
1100	
1101	
1110	
1111	
0000	Oscillator is disabled at this point.

the oscillation is 2kHz as determined by R3, C4. Each pulse in the 2kHz pulse train at pin 8 of U4C acts as the 8 bit set pulse for counter U2. Thus, commands are updated at a 2kHz rate. Since this rate is faster than the instrument can respond, command appears continuous.

6-17. TRIGGERED COMMAND MODE. In this mode of operation, P19-35 (AUTO COMMAND DEFEAT) is held at logic level "0" and an external trigger is applied to P19-33 (EXTERNAL COMMAND ENTRY). With a logic level "0" at P19-35 gate U4A is disabled. The application of an external pulse to P19-33 will enable the schmitt trigger circuit, gates U4B, C and D, resulting in a negative pulse presented to the counter. As in the continuous command mode, this pulse initiates the command update cycle.

6-18. DIGITAL MULTIPLEXER. The Digital Multiplexer U3 is a medium scale integrated circuit constructed to connect various input signals, one at a time, to a single two-phase output in response to certain input addresses. Table 6-4 defines its operation. The output is serialized into eight time slots; each is 1μs in length.

6-19. PULSE TRANSFORMER CIRCUITRY. The purpose of this circuitry is to couple the serialized information to the shift register and provide isolation. Gates U1A and U1B pass the serialized information to primaries of pulse transformers T1 and T2 through buffer Q1, Q2, Gate U1A passes logic "1" information, and gate U1B passes Logic "0" information. The secondaries of T1 and T2 impose their respective logic to buffers Q4 and Q5 and thereby to the shift register.

6-20. 8 BIT SHIFT REGISTER MEMORY. J-K flip flops U7A & B, U8A & B, U9A & B and U10A & B comprise the shift register. Diodes CR10, CR11, resistors R23, R24 comprise the clock network for the flip flops. The loading of the shift register occurs at pins 2 and 3 of U7A. The logic sequencially shifts through the flip flops until the last pulse of the loading cycle is loaded into U7A. At this time the shift register is fully loaded and will not change until another loading cycle occurs.

6-21. 8 BIT LATCH BUFFER MEMORY. U11 and latch clock network, transistor Q5, diodes CR6 and CR7 plus capacitor C5, comprise the 8 Bit Latch Buffer Memory circuit. During the loading cycle of the 8 bit shift register memory circuit, transistor Q5 is turned on, which disconnects the inputs of ICU11 to preclude undesirable pulsing of output lines during the loading cycle. After the shift register is fully loaded, transistor Q5 turns off, thereby allowing the outputs of U11 to assume the states of the present inputs.

6-22. DECODERS. Decoder-buffers U12, U13, U14 and transistors Q6-Q11 decode the U11 latch information to the same format as seen on the inputs. Diodes CR21, CR22 provide for external reference lockout in Ohms and KΩ functions as is done by the front panel pushbuttons when the instrument is commanded locally.

6-23. MAINTENANCE

6-24. Introduction

6-25. This section contains maintenance information for the Remote Control Unit. Factory service information and general instructions regarding instrument access and cleaning are located in Section 4 of the manual.

Table 6-4. MULTIPLEXER OPERATION

IF THE INPUT ADDRESS IS:			THEN OUTPUT PIN 15 HAS THE SIGNIFICANCE	AND OUTPUT PIN 14 HAS THE SIGNIFICANCE	CHANNEL INFORMATION IS:
PIN 13	PIN 12	PIN 11			
0	0	0	R (pin 1)	$\overline{R}$	FUNCTION BIT
0	0	1	N (pin 2)	$\overline{N}$	FUNCTION BIT
0	1	0	L (pin 3)	$\overline{L}$	FILTER
0	1	1	K (pin 4)	$\overline{K}$	EXTERNAL REFERENCE
1	0	0	J (pin 5)	$\overline{J}$	AUTORANGE
1	0	1	H (pin 6)	$\overline{H}$	RANGE LSB
1	1	0	G (pin 7)	$\overline{G}$	RANGE BIT
1	1	1	F (pin 9)	$\overline{F}$	RANGE MSB

6-26. Performance Test

6-27. The following performance test exercises each RCU input to determine if the unit is working properly. The performance test should be conducted before any instrument maintenance is attempted. The test should be conducted under the following environmental conditions: Ambient Temperature 0°C to 50°C, Relative Humidity less than 70%. An instrument that fails the performance test will require corrective maintenance. In case of difficulty, analysis of the test results, with reference to the troubleshooting section, should help to locate the trouble.

6-28. To test the RCU, proceed as follows:

a. Supply +5 volts dc to the RCU, P19-9 (+5V dc) and P19-2 or 4 or 6 (common).

b. Press REMOTE FUNCTION switch on the Model 8375A front panel.

c. Activate each of the combination of functions and ranges shown in column 1 and 2 of Figure 6-3 by contact closure between the appropriate pin and common of the RCU connector (refer to Table 2-5 of Section 2 for connector pin assignments). Observe the resulting front panel display and verify correct response for each call combination listed in Figure 6-3. Function annunciator will not show option functions if the pertinent option is not installed.

COMMANDED		DVM RESPONSE												
		FUNCTIONS							RANGES					
FUNCTIONS	RANGES	DC	AC	KΩ	Ω	X REF	FILT	OVER	.1	1	10	100	1000	10K
FILT, EXT REF*	.1	0			0	0			0					
	1	0			0	0				0				
	10	0			0	0					0			
	100	0			0	0						0		
	1000	0			0	0							0	
	NONE	0			0	0			Down ranges from 1000 to .1					
FILT, EXT REF,* Ω*	10			0							0			
	100			0		0						0		
	1000			0		0							0	
	10K			0		0								0
FILT, EXT REF,* KΩ	100		0			0						0		
	1000		0			0							0	
	10K		0			0								0
	NONE		0			0			Autoranges in the following order: 10,000K, 1000K, 100K, 10Ω and STOP					
EXT* REF, VAC	1		0		0					0				
	10		0		0						0			
	100		0		0							0		
	1000		0		0								0	
	NONE		0		0				Downranges from 1000 to 1					

* Options Disregard DMM response for these functions if option is not installed.

Figure 6-3. REMOTE CONTROL UNIT TEST REQUIREMENTS

6-29. Calibration

6-30. The RCU does not require calibration.

6-31. Troubleshooting

6-32. This section contains information designed to aid in troubleshooting the RCU. Before attempting to troubleshoot the RCU, however, it should be verified that the trouble is actually in the instrument and is not caused by faulty external equipments or improper control settings. For this reason, the performance test (paragraph 6-26) is suggested as a first step in troubleshooting. The performance test may also help to localize the trouble to a particular section of the instrument. If the performance test fails to localize the trouble, the trouble analysis flow chart in Figure 6-4 and code information in Figure 6-5 may be helpful.

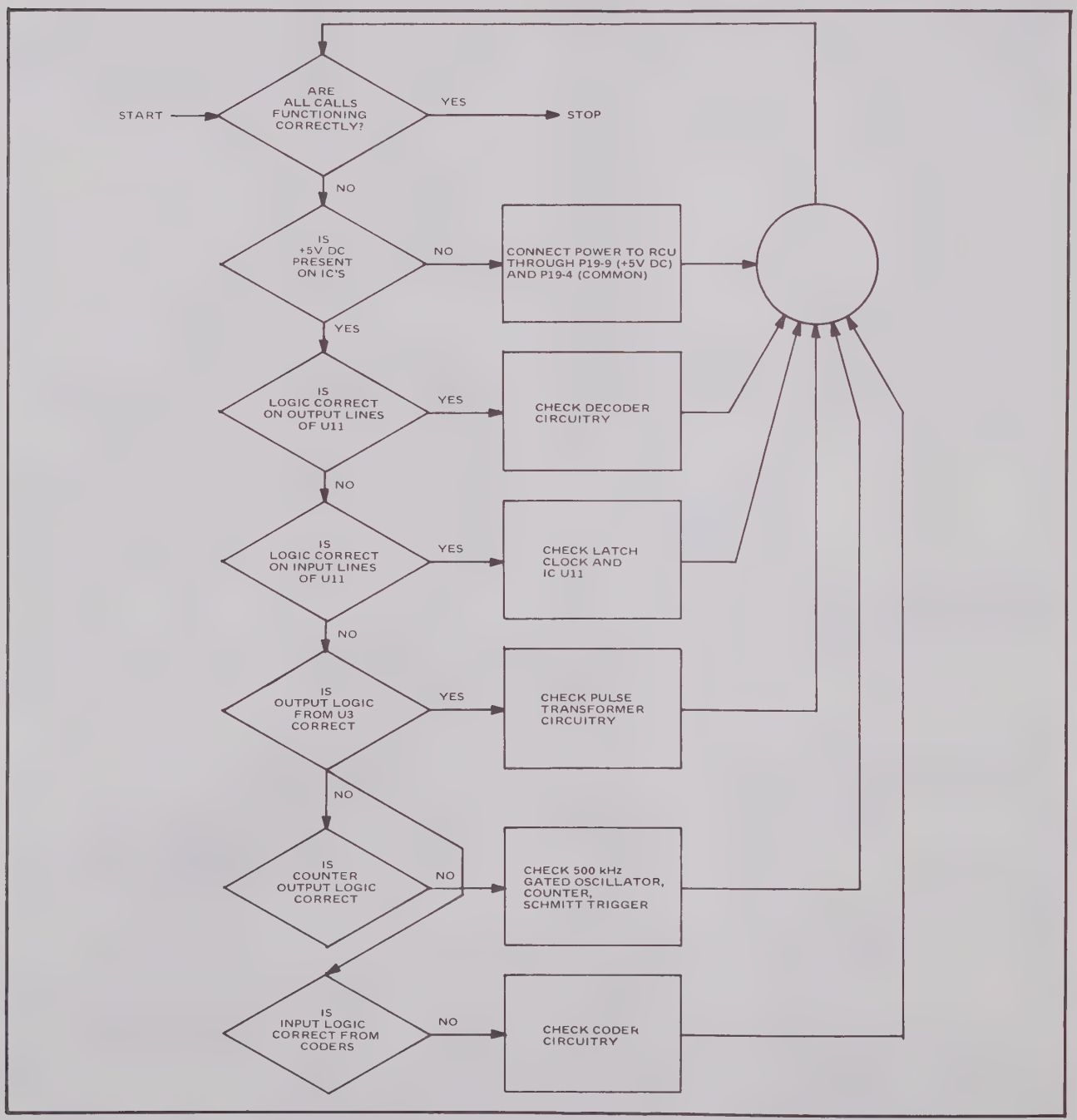


Figure 6-4. REMOTE CONTROL UNIT TROUBLE ANALYSIS (FLOW CHART)

RANGE CODES

F	G	H	J	RANGE
			0	AUTO
0	0	0	1	10,000
0	0	1	1	1000
o	1	0	1	100
0	1	1	1	10
1	0	0	1	1
1	0	1	1	0.1

FCT. CODES

N	R	FUNCTION
0	0	VDC
0	1	VAC
1	0	KΩ
1	1	Ω

Figure 6-5. FUNCTION AND RANGE CODES

6-33. LIST OF REPLACEABLE PARTS

6-34. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5, paragraphs 5-1 through 5-10. See paragraph 6-35, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

A5, REMOTE CONTROL PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5	**REMOTE CONTROL PCB ASSEMBLY (–04 Option) Figure 6-6**	8375A-04			
C1,C2	Cap, mica, 1500 pf ± 5%, 500V	148361	2		
C3	Cap, mylar, .01μf ± 20%, 100V	149753	1		
C6,C15	Cap, cer, 1200 pf, ± 10%, 500V	106732	2		
C4	Cap, Ta, 3.3μf ± 10%, 35V	182808	1		
C5	Cap, Ta, 1μf ± 20%, 35V	161919	1		
C7	Cap, elect, 200μf +50/–10%, 10V	236935	1		
C9	Cap, mica, 33pf ± 5%, 500V	160317	1		
C10,C11	Cap, cer, .025μf ± 20%, 50V	168435	2		
C12,C13	Cap, cer, .005μf ± 20%, 50V	175232	2		
C14	Cap, Tan, 39μf ± 20%, 20V	163915	1		
CR1 thru CR12, CR19 thru CR28	Diode, germanium, 80mA, 100 piv	149187	22		
CR13 thru CR18,CR29 thru CR32, CR36	Diode, silicon, 150mA	203323	11		
Q1,Q2,Q12, Q15	Tstr, silicon, NPN	218396	4		

A5, REMOTE CONTROL PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q3,Q4,Q5, Q8,Q9	Tstr, silicon, PNP	195974	5		
Q6,Q7, Q10,Q11	Tstr, silicon, PNP, selected	280198	4		
R1,R2	Res, comp, 820Ω ± 5%, 1/4w	148015	2		
R3	Res, comp, 47Ω ± 5%, 1/4w	147892	1		
R4,R5	Res, comp, 1k ± 5%, 1/4w	148023	2		
R6,R7	Res, comp, 100Ω ± 5%, 1/4w	147926	2		
R8,R9	Res, comp, 330Ω ± 5%, 1/4w	147967	2		
R10,R19	Res, comp, 3.3k ± 5%, 1/4w	148056	2		
R11	Res, comp, 2.2k ± 5%, 1/4w	148049	1		
R12,R25	Res, comp, 10k ± 5%, 1/4w	148106	2		
R13,R18, R20	Res, comp, 270Ω ± 5%, 1/4w	160804	3		
R14 thru R17	Res, comp, 390Ω ± 5%, 1/4w	147975	4		
R21,R22	Res, comp, 15k ± 5%, 1/4w	148114	2		
R23,R24	Res, comp, 1.2k ± 5%, 1/4w	190371	2		
R26,R27	Res, comp, 4.7k ± 5%, 1/4w	148072	2		
T1,T2	Transformer, pulse	275362	2		
U1	IC, TTL, Quad 2-Input Nor Gate	288845	1		
U2	IC, DTL, Binary Counter	267153	1		
U3	IC, TTL, Digital Multiplexer	288852	1		
U4	IC, TTL, Quad 2-Input Nand Gate	292953	1		
U6,U12, U13,U14	IC, DTL, Quad 2-Input Nand Gate	268375	4		
U5	IC, DTL, dual 4-Input Nand	268383	1		
U7	IC, TTL, dual J-K Flip-Flop	268441	1		
U8,U9,U10	IC, DTL, dual J-K Flip-Flop	288803	3		
U11	IC, TTL, 8-bit Latch	288837	1		
U15	IC, DTL, Hex Inverter	268367	1		
	Socket, IC, 14 contact, U1, U2, U4, U5, U6, U8, U9, U10 & U12 thru U15	276527	12		
	Socket, IC, 16 contact, U3 & U7	276535	2		
	Socket, IC, 24 contact, U11	292946	1		

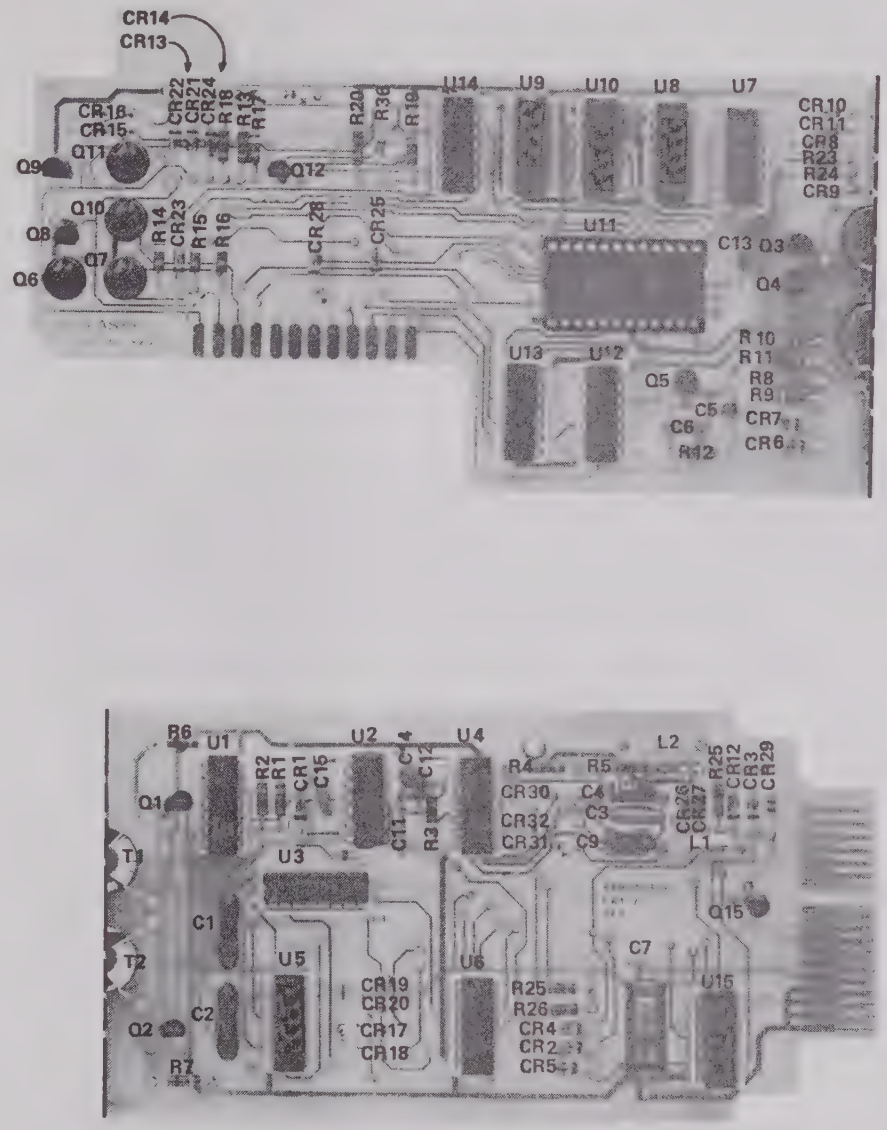


Figure 6-6. REMOTE CONTROL PCB ASSEMBLY

Option–05
DC External Reference

6-1. INTRODUCTION

6-2. The DC External Reference (Option –05) enables the user to substitute an external voltage for the internal reference of the Model 8375A. The principal use of the DMM when operated in this matter is for four-wire voltage ratio measurements: ±dc to dc, and ac to dc.

6-3. SPECIFICATIONS

6-4. Specifications for the DC External Reference are located in Section 1 of the manual.

6-5. INSTALLATION

6-6. The following procedure should be used to install the DC External Reference option in the Model 8375A.

a. Disconnect power cord from line power.

b. Remove the Model 8375A top dust cover and top inner guard chassis cover.

c. Determine that connector J3 on A14 Display board is clear of obstructions and that alignment keys are inserted between pin pairs J3-1, -2; J3-3, –4 and J3-13, -14; J3-15, -16.

d. Remove connector mounting bracket located on rear portion of inner chassis, next to power transformer.

e. Mount the DC External Reference connector to the connector bracket with orientation as shown on the rear panel decal. The lug attached to pin 1 of the connector is to be attached to the guard chassis through one of the mounting screws on the DC External Reference connector.

f. Reinstall connector mounting bracket on the inner chassis.

g. Align DC External Reference board with vertical card guides mounted on inner chassis bulkhead.

h. Align rubber grommet with slot in rear inner chassis and slide grommet into slot.

i. Slide DC External Reference board downward while observing that alignment keys on J3 are in proper alignment with the slots in the printed circuit board.

j. Engage printed circuit board fully in J3 connector.

k. Attach guard and top dust covers, connect power cord to line power, and perform receiving inspection test of DC External Reference assembly as described in paragraph 6-26, Performance Test.

6-7. OPERATING INSTRUCTIONS

6-8. Operating instructions for the Model 8375A with DC External Reference installed are located in Section 2 of the manual.

6-9. THEORY OF OPERATING

6-10. General

6-11. The DC External Reference unit consists basically of an input divider, an isolation circuit, and a buffer amplifier, as shown in Figure 6-1.

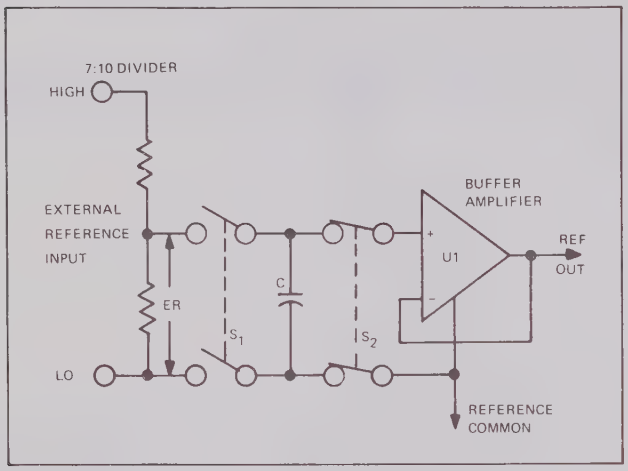


Figure 6-1. DC EXTERNAL REFERENCE SIMPLIFIED DIAGRAM.

The input divider produces an output that is 7/10 of the reference input voltage. The circuit is designed to operate with a reference input voltage between +1 and +10.5 volts dc. The isolation circuit provides a means of isolating the input common of the DC External Reference unit from the output common of the DC External Reference unit. This is necessary to provide 4 terminal ratio capability, and because the Model 8375A input common terminal (LO) and the instrument common are not equivalent. In fact, the LO instrument INPUT terminal is the actual input to the A/D Converter and can have a potential of ±12 volts dc with respect to instrument common. Switches S1 and S2 are arranged so that when one is closed, the other is open. S1 is closed during a non-critical portion of the measurement cycle (A/D zero time) and capacitor C is allowed to charge to voltage E_R. When S2 is closed, the output of U_1 must be E_R.

6-12. Circuit Description

6-13. INPUT DIVIDER. The input divider consists of resistors R3 through R5. The input divider is adjusted by resistor R4, (10V CAL control). Capacitor C1 together with the divider resistors form an RC filter which improves the signal to noise ratio.

6-14. ISOLATION CIRCUIT. Input dual MOSFET Q9 functions as switch S1 in the simplified diagram and JFET switches Q4 and Q5 function as switch S2. Transistors Q1 and Q2 are gate drivers for switches Q4 and Q5. Using the reference voltage for the collector supply of Q2 assures that the gate signal of Q4 never goes positive with respect to its source and drain terminals. The gate of Q5 is clamped to within 0.2 volts of common by diode CR3. Resistor R11 limits the current through CR3 and capacitor C4 compensates for the capacity of CR3.

6-15. BUFFER AMPLIFIER. The buffer amplifier consists of super beta transistor Q8 followed by operational amplifier U1. Transistor Q7 and resistor R23 comprise a constant current source for amplifier Q8. Resistor R29 provides base current for the input terminal of transistor Q8. Transistor Q6 and associated circuitry provide a constant current source for the collectors of Q8. Transistor Q8 is bootstrapped by the output of amplifier U1, via resistors R15 and R16, to increase the SMRR of the buffer amplifier. Frequency compensation is provided by capacitors C7, C8. Capacitor C6 holds the input voltage to the buffer amplifier during the time switches Q4 and Q5 are off. The reference voltage in the A/D Converter is sensed through resistor R28, thereby compensating for line drops. Low sense (reference common) also originates in the Logic and A/D assemblies. Diodes CR8 and CR9 provide feedback to the voltage follower input when reed relay K1 is open, thereby maintaining amplifier output within 0.5 volts of the voltage on C2 and thus controlling the gate drive for Q4. Resistors R30 through R32, coupled with resistor R28, generate small corrections in the output reference voltage to compensate small errors proportional to the voltage difference between the input common and circuit common.

6-16. VOLTAGE DISTRIBUTION. Voltage distribution is shown in the simplified schematic Figure 6-2. Since Q9 is a P-channel enhancement mode device, a negative gate voltage of 2 volts or more is needed to ensure that the transistor is on. Zero volts or a positive gate voltage turns the transistor off. As shown in the figure, the upper switch needs a minimum of −7.25 volts to turn on and a maximum of ~20 volts to turn off under all possible operating circumstances.

6-17. The MOSFET gate driver is redrawn in Figure 6-3 to show the peak voltages. When Q3 is saturated, CR4 is back biased. When the transistor is cutoff, C5 charges to 8 volts because of the 12 volt drop across the zener. This voltage subtracts from the collector voltage giving the voltage shown.

6-18. DISABLE AND PROTECTION CIRCUITS. When the external reference is called, relay K1 is energized by Q10 and the internal reference disable line is pulled to +5V. Input protection is provided by diodes CR1 and CR2 and fuse F1.

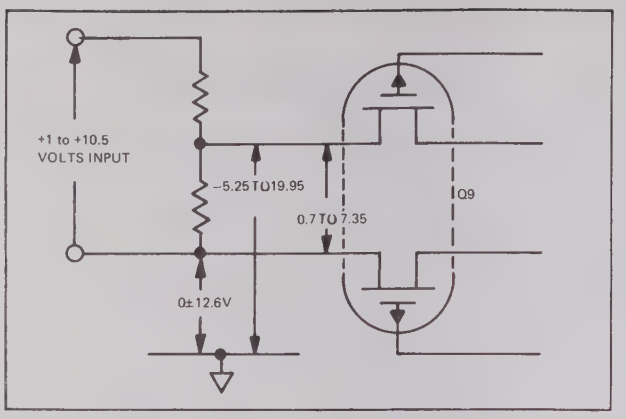


Figure 6-2. VOLTAGE DISTRIBUTION IN MOSFET Q9.

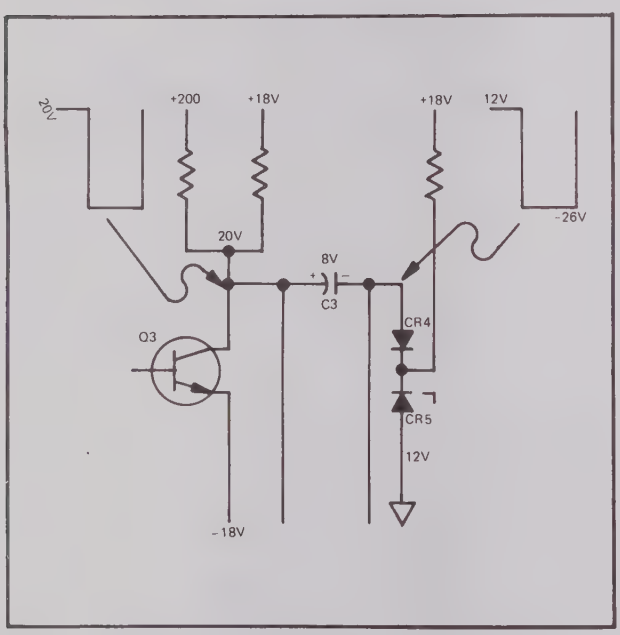


Figure 6-3. GATE DRIVER VOLTAGES.

6-19. MAINTENANCE

6-20. Introduction

6-21. This section contains maintenance information for the DC External Reference. Factory service information and general instructions regarding instrument access and cleaning are located in Section 4 of the manual.

6-22. Fuse Replacement

6-23. There are two fuses located on the DC External Reference board. F1 is the active fuse and is to be replaced with the SPARE FUSE when necessary. Both fuses are 15 ma, pigtail fuses.

6-24. Test Equipment

6-25. The following equipment is recommended for performance testing, troubleshooting, and calibration of the DC External Reference. If the recommended equipment is not available, equivalent or better instruments may be substituted.

EQUIPMENT NOMENCLATURE	RECOMMENDED EQUIPMENT
DC Voltage Source	Fluke Model 343A DC Voltage Calibrator
Kelvin Varley Divider	Fluke Model 720A
Oscilloscope	Tektronix Model 547
Oscilloscope Plug-IN	Tektronix Model 1A1

6-26. Performance Test

6-27. The performance test in this section compares the DC External Reference performance to the accuracy specifications in Section 1 of the manual to determine if the unit is in calibration. To test the unit, a reference voltage is applied to the DC External Reference input terminals, a dc voltage is applied to the DMM INPUT terminals, and proper DMM readout is verified. The performance test should be conducted before any instrument maintenance or calibrating is attempted. The test is also suited to receiving inspection of new units. Performance test should be conducted under the following environmental conditions: ambient temperature 23°C ±5C, relative humidity less than 70%. An instrument that fails the performance test will require corrective maintenance or calibration. In case of difficulty, analysis of the test results, with reference to the troubleshooting section, should help to locate the trouble.

NOTE!

Permissible tolerances for voltage and resistance measurements are derived from the 90-day instrument specifications contained in Section 1 of the manual.

6-28. To test the DC External Reference unit, proceed as follows:

a. Connect the dc voltage source to the Model 8375A as shown in Figure 6-4.

b. Set the Model 8375A controls as follows:

POWER	ON
FUNCTION	EXT REF, VDC
RANGE	10

c. Set the dc voltage source controls for 10 volt dc output.

d. The Model 8375A readout should be +10.0000 ±0.0007.

6-29. Calibration

6-30. The DC External Reference Unit should be calibrated every 90 days or whenever repairs have been made to circuitry which may affect the calibration accuracy. Calibration of the unit should be performed at an ambient temperature of 23°C ±2°C. Relative humidity should be less than 70%. Consult paragraph 6-4 for recommended test equipment.

6-31. PRELIMINARY OPERATIONS

a. Remove the top dust cover retaining screws but leave the dust cover in place on the instrument.

6-32. ALIGNMENT

a. Set Model 8375A controls as follows:

FUNCTION	EXT REF, VDC
RANGE	10
SAMPLE RATE	as desired

b. Set the 720A dials to 8005000.

c. Set the 343A output to 10 volts.

d. Adjust DC EXT REF 10V CAL (A3R4) in the DC External Reference Unit for a readout of 8.0050.

e. Set the 343A output to 2 volts.

f. Adjust DC EXT REF 2V CAL (A3R20) in the DC External Reference Unit for a readout of 8.0050 ±1 digit.

g. Repeat steps (b) through (f), as required, until no more adjustment is necessary.

h. Set the 343A output to 10.000 volts.

i. Record DMM reading.

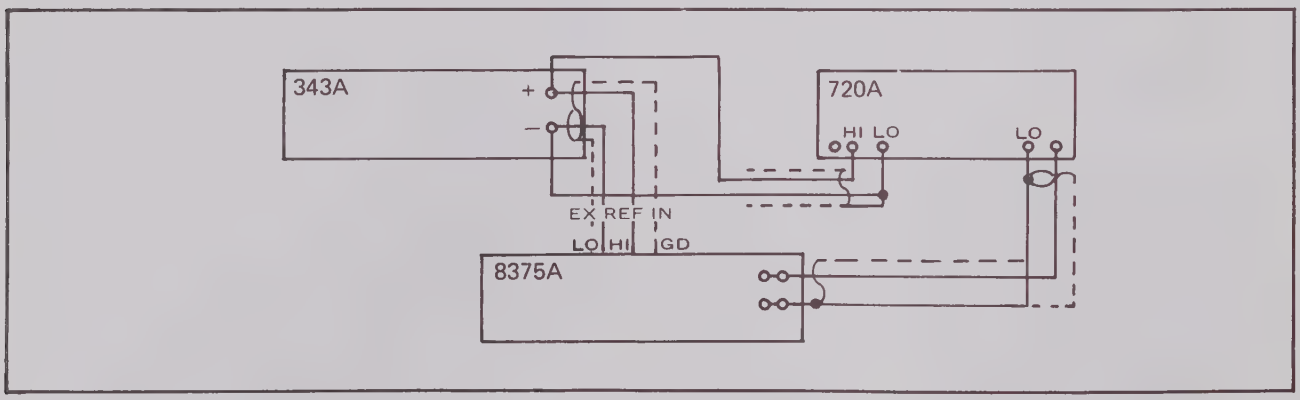


Figure 6-4. EQUIPMENT CONNECTIONS FOR DC EXTERNAL REFERENCE UNIT CALIBRATION.

b. Set the rear panel 115/230 volt slide switch to the 115 volt position and connect the line cord to an autotransformer set to 120 volts ac.

c. Connect equipment as shown in Figure 6-4.

d. Turn on the Model 8375A and allow the instrument to operate for one hour.

j. Reverse the input to the DMM only. DMM reading should be within 2 digits of value recorded in step (i).

k. Reverse the input to the DMM only, and set calibrator to 5.0 volts.

l. DMM readout should be 8.0050 ±3 digits.

m. Disconnect calibration equipment from Model 8375A.

6-33. Troubleshooting

6-34. This section contains information designed to aid in troubleshooting the DC External Reference Unit. Before attempting to troubleshoot the unit, however, it should be verified that the trouble is actually in the unit and is not caused by faulty external equipments or improper control settings. For this reason, the performance test (paragraph 6-26) is suggested as a first step in troubleshooting. The performance test may also help to localize the trouble to a particular section of the instrument. If the performance test fails to localize the trouble, the following information may be helpful.

6-35. OSCILLOSCOPE CONNECTIONS. To observe waveforms on the DC External Reference Unit, it will be necessary to synchronize the oscilloscope with the $\overline{\text{ZERO}}$ signal. Connect a lead from the scope external trigger input to A8TP3, with scope common connected to A8TP1. Connect the scope input probe also to A8TP3 and adjust the scope trigger controls so that it triggers on the negative going edge of the $\overline{\text{ZERO}}$ pulse.

6-36. VOLTAGE AND WAVEFORM CHECKS. If the reference voltage stays at about 7 volts no matter what the input reference voltage is, check transistor Q10, diode CR13, or transistor A8Q24.

6-37. If the reference output voltage is zero or negative, check the gate drives of Q9, Q4, and Q5. If either of the waveforms of Q9 are not correct (stylized waveforms are shown in Figure 6-5), check to see if the same defective waveform appears at other than the gate terminals of Q9; if it does, Q9 is defective and should be replaced. If Q9 does not check bad, gate driver Q3 is probably defective.

6-38. If the waveforms are correct, connect the external reference input LO terminal to instrument common and apply 10 ±0.1 volts to the external reference input HI terminal. The resulting voltage across capacitor C1 should be 7 ±0.1 volts. The voltage across C2 should be equal to the voltage across C1 less the amount drained by the measurement instrument. The voltage across both C1 and C2 will be pulled high if the output of U1 is higher than 8 volts. No voltage or extremely low voltage across C2 indicates Q9 is bad. Check integrated circuit U1 to see if pin 2 is low or high with respect to pin 3. If it is low, the output at pin 6 of U1 should be +18 volts; if it is high, the output should be −18 volts. The combined voltage developed across R17, R18, R21 and R22 should be about 9.2 volts. If not, check the following components in the order given: U1, Q7, or Q8. If the unit operates normally with the LO reference input terminal connected to DMM common but does not operate properly with the LO terminal high or low with respect to DMM common, suspect Q9, Q5, CR4, or CR5.

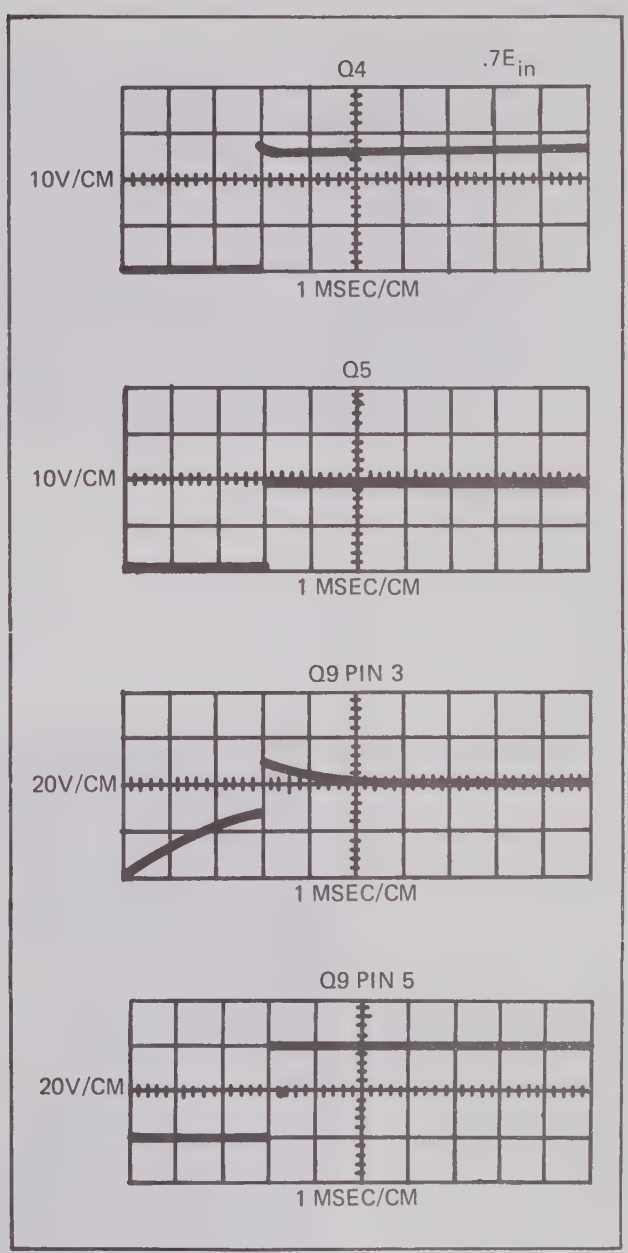


Figure 6-5. DC EXTERNAL REFERENCE STYLIZED WAVEFORMS.

6-39. LIST OF REPLACEABLE PARTS

6-40. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5, paragraphs 5-1 through 5-10. See paragraph 6-41, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

A3, DC EXTERNAL REFERENCE PCB ASSEMBLY

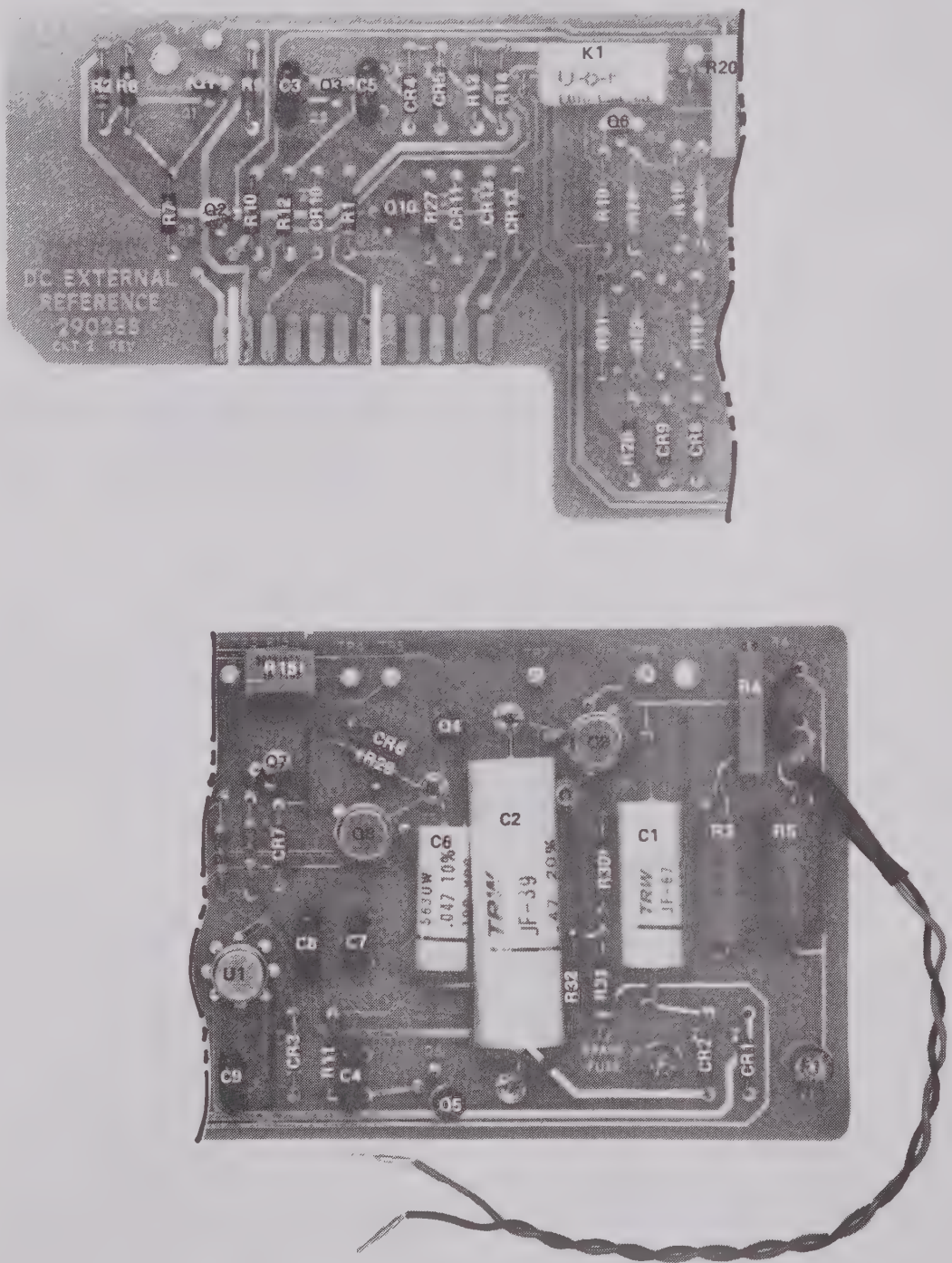


Figure 6-6. DC EXTERNAL REFERENCE PCB ASSEMBLY

A3, DC EXTERNAL REFERENCE PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	DC EXTERNAL REFERENCE				
A3	**PCB ASSEMBLY (–05 Option)**	8375A-05	REF		
	Figure 6-6				
C1	Cap, plstc, 0.1 uf ±20%, 120V	167460	1		
C2	Cap, plstc, 0.47 uf ±20%, 120V	190553	1		
C3	Cap, mica, 100 pf ±5%, 500V	148494	1		
C4	Cap, mica, 47 pf ±5%, 500V	148536	1		
C5, C7, C8	Cap, mica, 220 pf ±5%, 500V	170423	3		
C6	Cap, plstc, 0.047 uf ±10%, 120V	260562	1		
C9	Cap, mica, 33 pf ±5%, 500V	160317	1		
CR1, CR2, CR4, CR6, CR7, CR8, CR9	Diode, silicon, 150 mA, 125 piv	272252	7		
CR3	Diode, fast switching, germanium, 40 mA, 50 piv	180505	1		
CR5	Diode, zener, 5.1V	159780	1		
CR10, CR13	Diode, germanium, 80 mA, 100 piv	149187	2		
CR11, CR12	Diode, silicon, 150 mA	203323	2		
F1, F2	Fuse, pigtail, 15 mA, 125V (F2 fuse is a spare)	285031	2		
K1	Relay, Reed switch Coil, relay	219097 269019	1 1		
Q1, Q6, Q10	Tstr, silicon, PNP	195974	3		
Q2, Q3, Q7	Tstr, silicon, NPN	218396	3		
Q4, Q5	Tstr, J-FET, N-channel	271924	2		
Q8	Tstr, silicon, NPN, Super beta dual monolithic	284075	1		
Q9	Tstr, FET, dual, P-channel	268011	1		
R1	Res, comp, 4.7k ±5%, 1/4w	148072	1		
R2	Res, comp, 33k ±5%, 1/4w	148155	1		
R3, R5	Res, set, ext ref, divider	278309	1		
R4, R20	Res, var, cer met 5k ±20%, 1/2w	267872	2		
R6	Not used				
R7, R8, R13	Res, comp, 22k ±5%, 1/4w	148130	3		
R9	Res, comp, 6.8k ±5%, 1/4w	148098	1		
R10, R28	Res, comp, 12k ±5%, 1/4w	159731	2		

A3, DC EXTERNAL REFERENCE PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R11	Res, comp, 120k ±5%, 1/4w	193458	1		
R12	Res, comp, 2.2M ±5%, 1/4w	198390	1		
R14	Res, comp, 180k ±5%, 1/4w	193441	1		
R15	Res, var, cer met, 1k ±10%, 1w	285155	1		
R16	Res, met flm, 1.54k ±1%, 1/8w	289066	1		
R17, R21	Res, selected in test (not shown on Figure 6-6)	▷1◁	2		
R18, R22	Res, met flm, 215k ±1%, 1/8w	289470	2		
R19	Res, met flm, 2k ±1%, 1/8w	235226	1		
R23	Res, met flm, 140k ±1%, 1/8w	289439	1		
R24	Res, met flm, 7.15k ±1%, 1/8w	260356	1		
R25	Res, met flm, 82.5k ±1%, 1/8w	246223	1		
R26	Res, met flm, 8.66k ±1%, 1/8w	260364	1		
R27	Res, comp, 1k ±5%, 1/4w	148023	1		
R29, R30, R32	Res, comp, 100M ±10%, 1/2w	190520	3		
R31	Res, comp, 4.7M ±10%, 1/2w	108308	1		
U1	IC, operational amplifier	271502	1		
XF1	Fuse holder	296582	2		
	Cable, Ref, input	304030	1		
	Terminal, teflon, feed thru, 4 lead	281865	4		
	▷1◁ R17 and R21 factory selected.				

Option –07
Rear Input

6-1. INTRODUCTION

6-2. The Rear Input Option provides INPUT HI, INPUT LO, Ω SENSE, Ω SOURCE and GUARD terminals at the rear of the instrument, in parallel with the front panel terminals.

6-3. INSTALLATION

6-4. The following procedure should be used to install the Rear Input Option:

a. Remove the instrument top dust and chassis guard covers.

b. Remove A13 TRUE RMS CONVERTER from instrument.

c. Remove connector bracket on inner chassis, right rear portion.

d. Mount Rear Input Connector onto the connector bracket top slot. Ensure that the lug which is attached to connector pin 2 is affixed to the inner guard chassis with one of the connector mounting screws.

e. Remount connector bracket to inner chassis.

f. Lay the Rear Input harness along side the Right side of the inner chassis and between the A14 Display PCB and TB1. Clamp harness to inner chassis.

g. Connect Rear Input harness to terminals on rear of the front panel binding posts as follows:

RED – INPUT HI
BLACK– INPUT LO
YELLOW– HI Ω SOURCE
BROWN– LO Ω SOURCE

h. Install the A13 True RMS Converter.

i. Attach guard and instrument dust cover.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	REAR INPUT –07 Option	1	REF		
	Cable, rear input	311639	1		
	Hardware kit, option	321661	1		
	Cable clamps	165951	2		
	1 Order by Mode and Option No (8375A-07 Option)				

6-5. LIST OF REPLACEABLE PARTS

6-6. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5, paragraphs 5-1 through 5-10. See paragraph 6-7, this option subsection for additional Use Codes and Serial Number Effectivity List assigned to this option.

6-7. SERIAL NUMBER EFFECTIVITY

6-8. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 8375A. Each part in this option for which a use code has been assigned may be identified with a particular printed circuit board serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all Rear Input Options with serial numbers 123 and on. NOTE: These Use Codes and Serial Number Effectivity apply to this option assembly only. For the standard instrument configuration, see Section 5, paragraph 5-9, and for additional options, see the appropriate option subsection.

USE CODE	SERIAL NUMBER EFFECTIVITY

Accessory

Rack Mounting Fixtures

6-1. INTRODUCTION

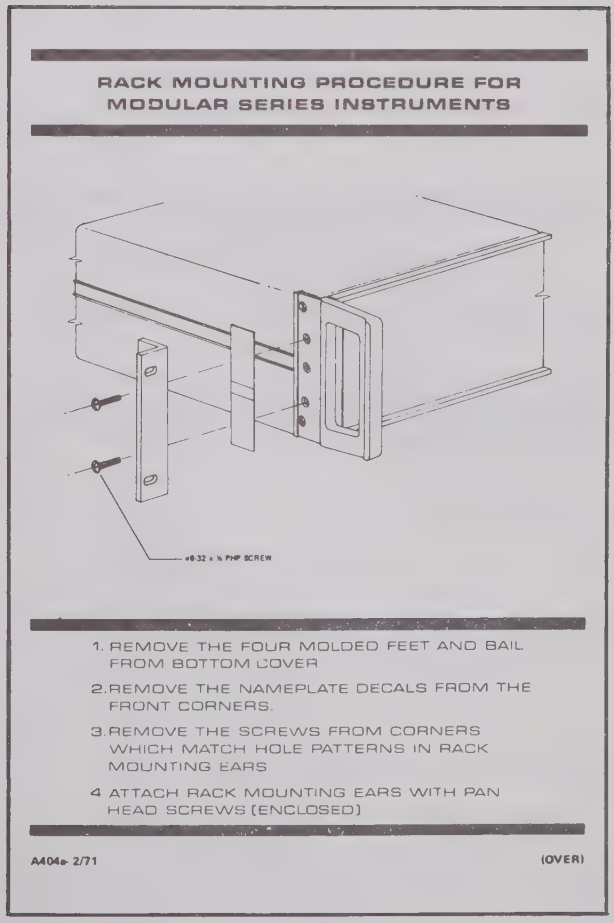
6-2. The Model 8375A can be mounted in a standard 18-inch or 24-inch deep equipment rack. The rack mounting kits are as follows:

KIT NAME	RACK KIT NO.
24-inch Rack Slide	MOO-280-610
Rack Ears	MO3-205-600

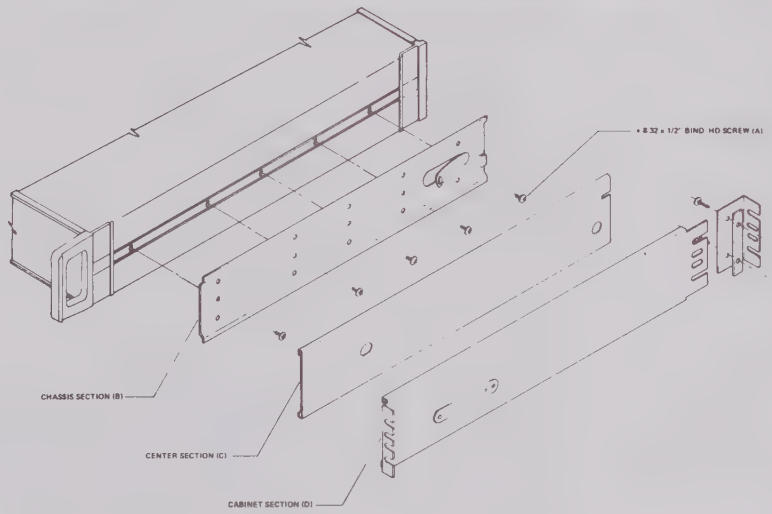
6-3. INSTALLATION

6-4. Procedures for installation of rack mounting kits are given in the following illustrations. Each illustration is identified with a form number in the lower lefthand corner. This form number is related to the kit number as follows:

FORM NO.	RACK KIT
A404a	MO3-205-600
A405	MOO-280-610


RACK MOUNTING PROCEDURE FOR
MODULAR SERIES INSTRUMENTS
1. REMOVE THE FOUR MOLDED FEET AND BAIL FROM BOTTOM COVER
2. REMOVE THE NAMEPLATE DECALS FROM THE FRONT CORNERS.
3. REMOVE THE SCREWS FROM CORNERS WHICH MATCH HOLE PATTERNS IN RACK MOUNTING EARS
4 ATTACH RACK MOUNTING EARS WITH PAN HEAD SCREWS (ENCLOSED)
A404a 2/71
(OVER)

RACK SLIDE MOUNTING PROCEDURE FOR MODULAR SERIES INSTRUMENTS.



1. REMOVE SIDE TRIM DECAL AND BOTTOM FEET FROM INSTRUMENT.
2. ATTACH CHASSIS SECTION (B) OF SLIDE TO INSTRUMENT WITH # 8-32 x 1/2" PHP SCREWS (A) (ENCLOSED) AS FOLLOWS:
   A. FOR 3–1/2", 7" AND 10–1/2" HIGH INSTRUMENTS UTILIZE THE CENTER ROW MOUNTING HOLES.
   B. FOR 5–1/4" AND 8–3/4" HIGH INSTRUMENTS UTILIZE EITHER THE UPPER OR LOWER ROW OF MOUNTING HOLES.
3. INSTALL CABINET SECTION (D) AND CENTER SECTION (C) OF SLIDE INTO RACK (EXTENSION ANGLE BRACKET AND HARDWARE ENCLOSED).
4. EXTEND CENTER SECTION (C) OF SLIDE TOWARD OPERATOR UNTIL IT LOCKS IN EXTENDED POSITION.
5. DEPRESS SPRING LOCK ON CHASSIS SECTION (B) AND INSERT INSTRUMENT BETWEEN EXTENDED SLIDE SECTIONS.

Form No. A405-3/71- Rev. 1

Accessory

DOU, RCU Mating Connector

6-1. INTRODUCTION

6-2. The mating connector shown in Figure 6-1 is required for interface between the Remote Control Unit and the programming equipment. It also provides interface between Data Output Unit No. 1 & 2 and external equipment. This connector is obtained when either option is ordered, or can be obtained by ordering from the factory, referencing FLUKE PART NO. 321687.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Wiring and assembly of the mating connector is done as follows:

a. Solder the wiring to the appropriate terminals of the connector. Refer to Figure 6-1, detail I for terminal locations. Functional pin assignments for the Remote Control Unit and the Data Output Unit No. 1 & 2 can be found in Section 2.

b. Mount alignment spacers (F) between proper pins on Connector (B). Spacer positions are given in Figure 6-2.

c. Mount Connector (B) into Backshell half (C). Refer to detail II of Figure 6-1.

d. Mount Backshell half (A) onto Backshell half (C). When correctly mounted together, the Backshell halves snap in place.

e. Secure Backshell halfs (A) and (C) together with 4 screws (D), supplied.

f. Secure Connector (B) to Backshell halfs (A) and (C) with two screws (E), supplied.

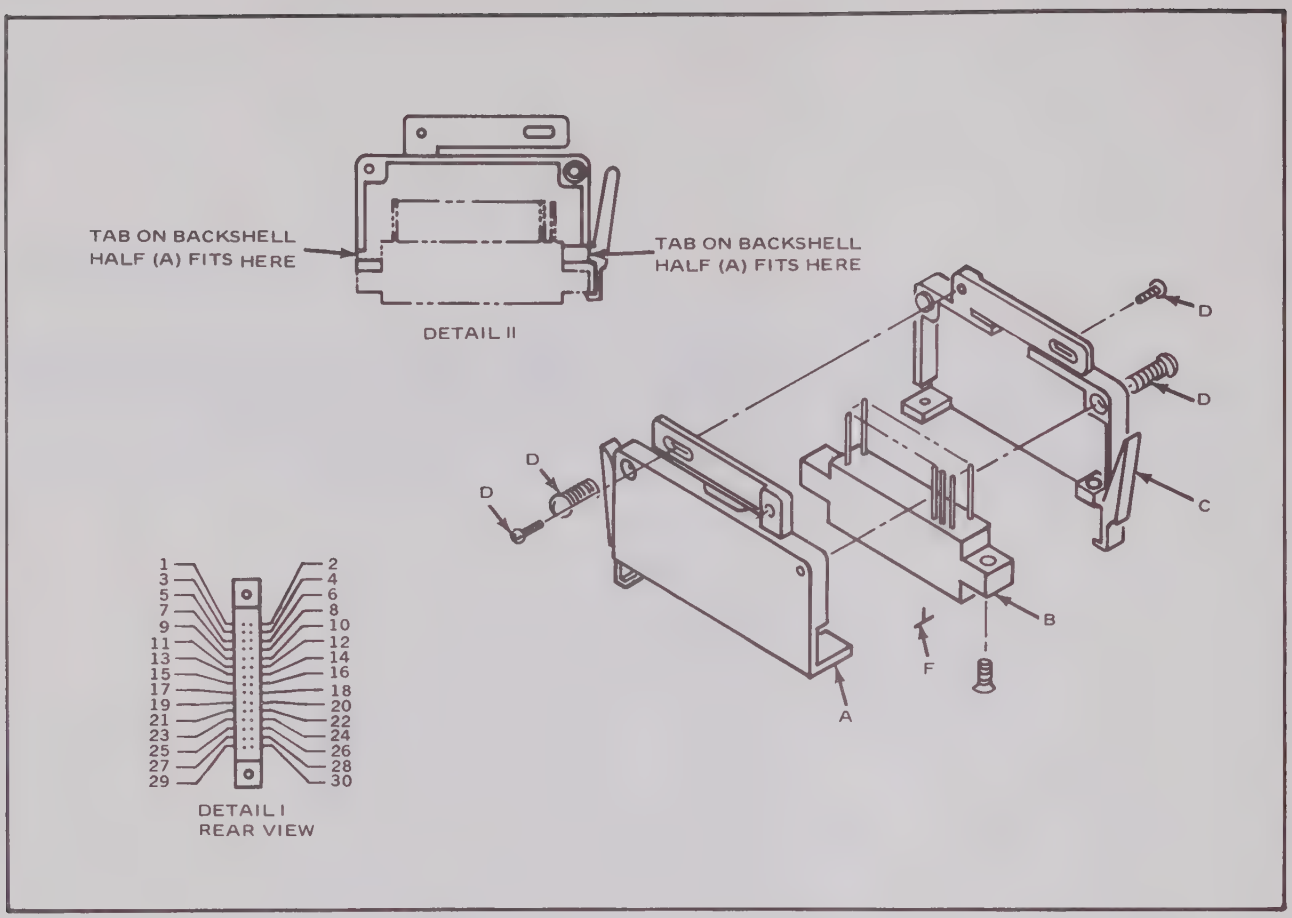


Figure 6-1. DOU, RCU MATING CONNECTOR

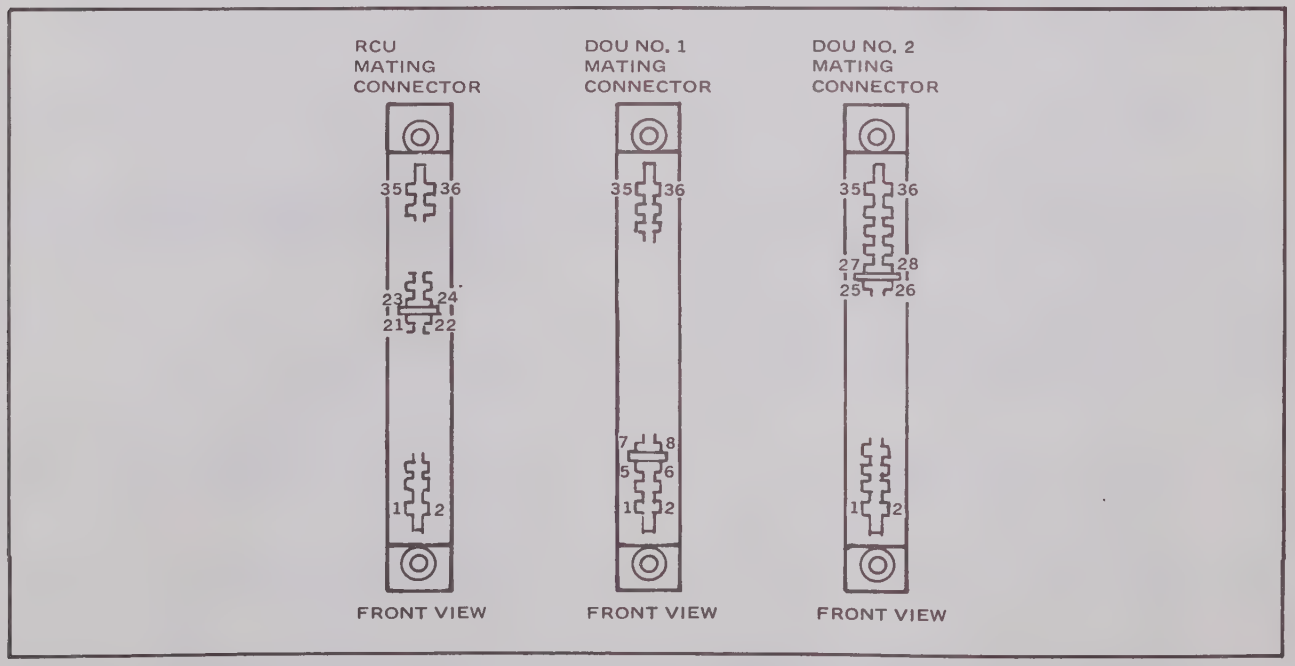


Figure 6-2. ALIGNMENT SPACER POSITIONS

Accessory

External Reference Mating Connector

6-1. INTRODUCTION

6-2. The mating connector shown in Figure 6-1 is required for interface between the DC External Reference connector and the external equipment. This connector is obtained when the option is ordered, or can be obtained by ordering from the factory by referencing FLUKE PART NO. 321679.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Wiring and assembly of the mating connector is done as follows:

a. Solder the wiring to Terminals (B).

b. Insert Terminals (B) in Connector (A). Refer to Figure 6-1 for terminal locations. Rear panel decal on instrument shows pin connections from External Reference Assembly to Connector.

c. Mount Cable Clamps (C) onto Connector (A) and secure with hardware (D) to Connector (A).

d. Secure both halfs of Cable Clamp (C) together with screws (E).

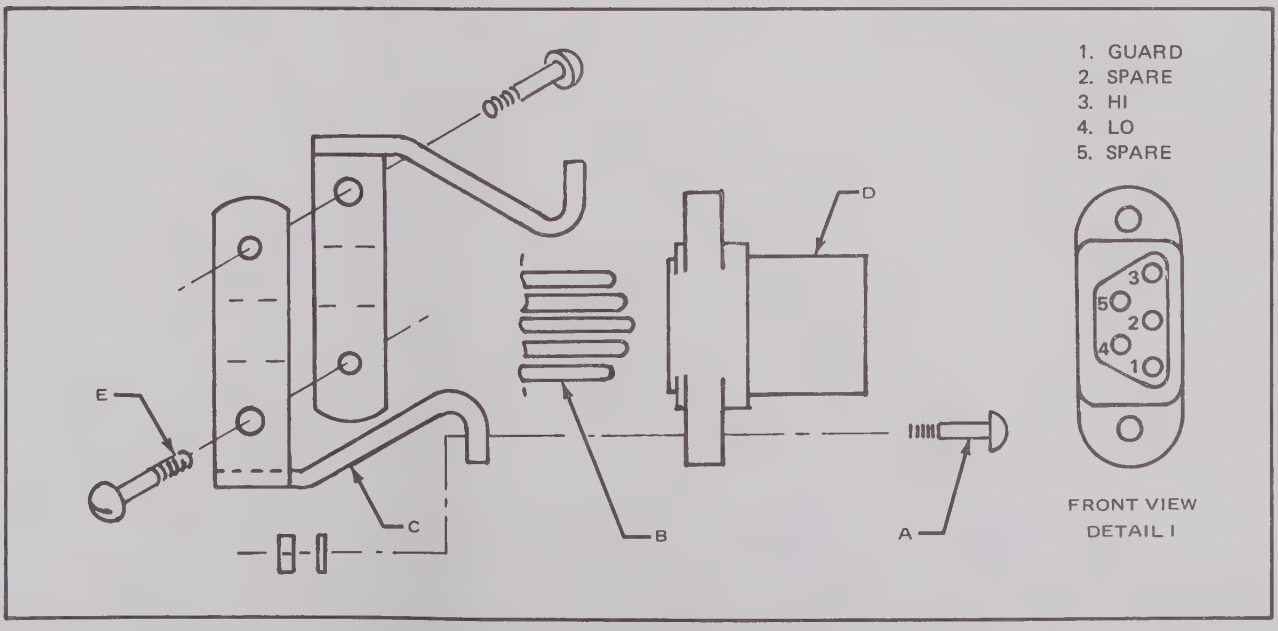


Figure 6-1. EXTERNAL REFERENCE MATING CONNECTOR

Accessory

Rear Input Mating Connector

6-1. INTRODUCTION

6-2. The mating connector shown in Figure 6-1 is required for interface between the rear panel INPUT connector and external equipment. This connector is obtained when the Rear Input Option (–07) is ordered, or can be obtained from the factory by referencing FLUKE PART NO. 321661.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Wiring and assembly of the mating connector is done as follows:

a. Solder wiring to connector pins (B).

b. Insert connector pins (B) into Connector (A). Refer to Figure 6-1 for terminal locations. Refer to the rear panel decal for functional pin assignments.

c. Mount and secure Cable Clamps (C) onto Connector (A) with proper hardware (D).

d. Secure Cable Clamps (C) together with screws (E).

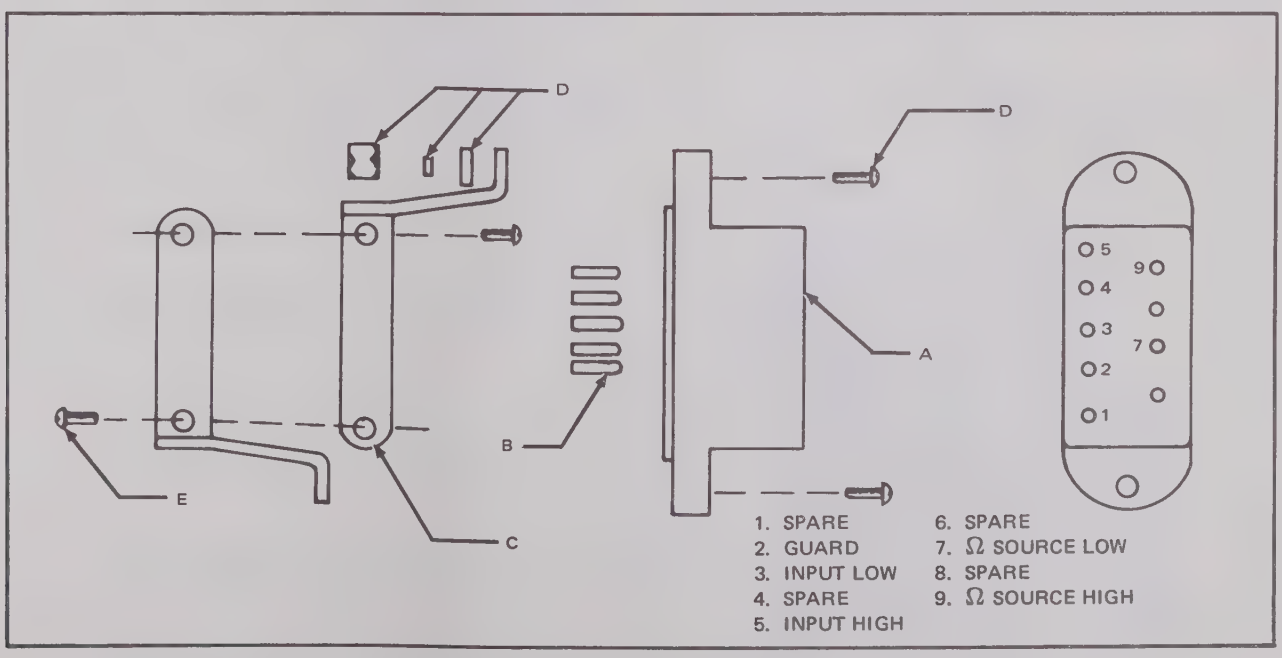


Figure 6-1. REAR INPUT MATING CONNECTOR

Accessory
Extender Card

6-1. INTRODUCTION

6-2. The Extender Card shown in Figure 6-1 is available as an Accessory for the FLUKE 8375A digital voltmeter. This accessory permits the printed circuit boards in the Model 8375A to be extended for servicing. The Extender Card can be obtained by ordering it under FLUKE PART NO. 298265.

6-3. INSTALLATION

6-4. To install a printed circuit board on the Extender Card proceed as follows:

a. Disconnect 8375A from line power.

b. Remove top dust and guard covers from instrument.

c. Locate the printed circuit board to be serviced and remove it from the instrument.

d. Install the Extender Card into the connector vacated by the removal of the printed circuit board.

e. Install the printed circuit board into the connector on the Extender Card. The printed circuit board must face the same direction as it did when installed into the instrument.

f. Connect 8375A to line power and turn on instrument. The printed circuit board can now be serviced.

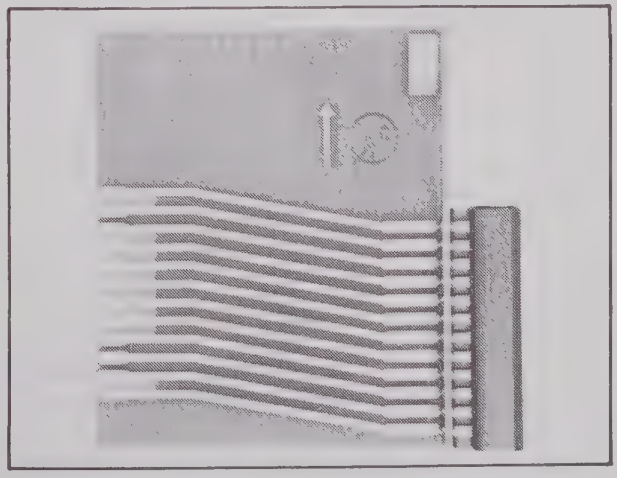


Figure 6-1. EXTENDER CARD

ACCESSORY INFORMATION

MODEL 80F-5 VOLTAGE DIVIDER

6-1. INTRODUCTION

6-2. The Accessory Model 80F-5 Voltage Divider allows measurement of up to 5k volts dc to be made using FLUKE 800, 900, and 8000 series voltmeters. Division ratio of this accessory is 1000:1. Accuracy and stability of the division ratio is ensured using special metal film resistors having matched temperature coefficients.

6-3. Physical design of the Model 80F-5 allows direct mating to the input terminals of the FLUKE voltmeters. A high voltage probe facilitates connection to the measure-

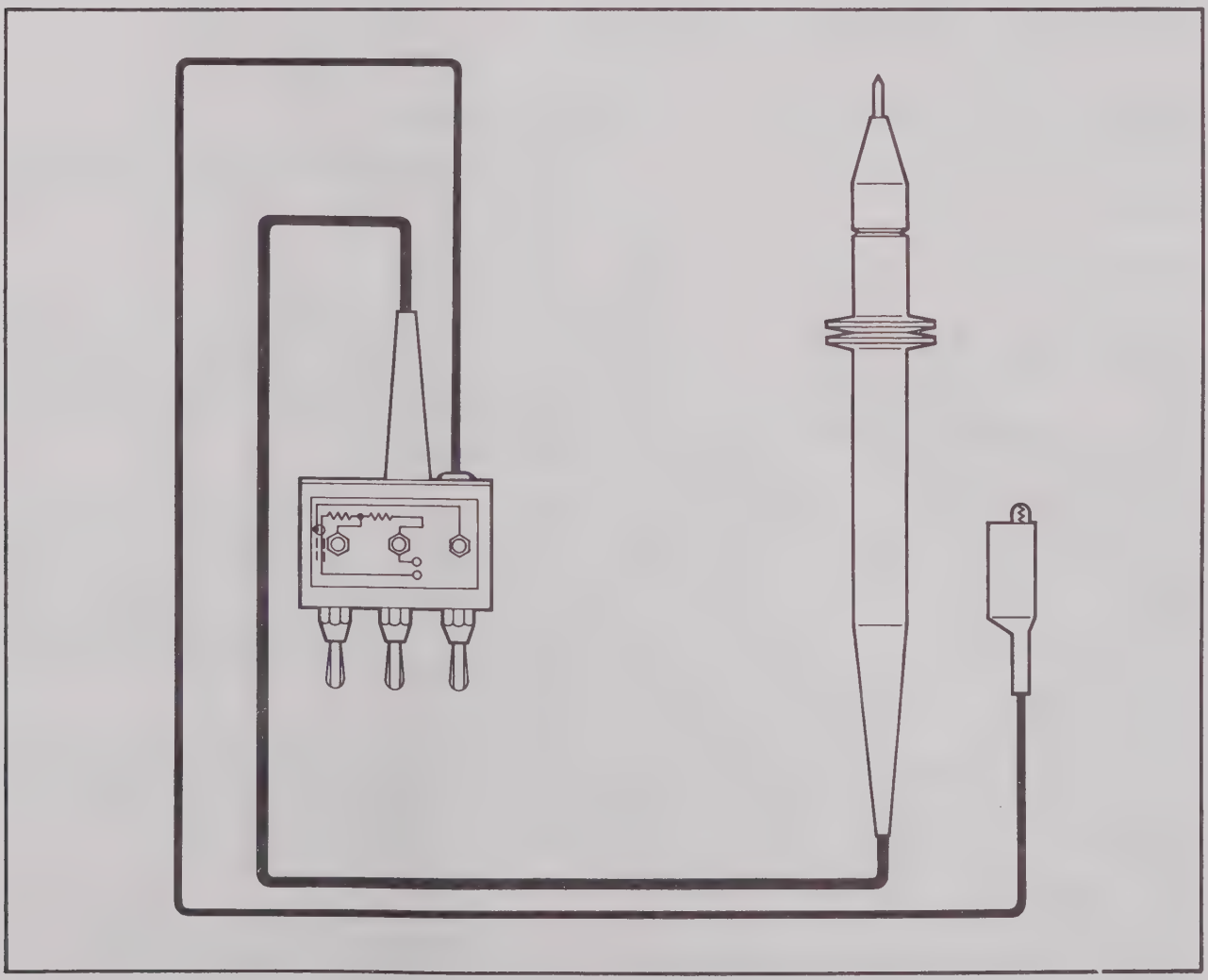


Figure 6-1. MODEL 80F-5 VOLTAGE DIVIDER

ment source. Maintenance is minimized by encapsulation of the divider components.

6-4. Three versions of the Model 80F-5 are available. The basic Model 80F-5 is used with voltmeters having a 10 megohm input resistance. An (01) Option is provided for voltmeters having an 11 megohm input resistance, and an (02) Option is provided for voltmeters having an infinite input resistance (10^3 megohms or greater) at null.

6-5. SPECIFICATIONS

6-6. Electrical

DIVISION RATIO:
1000:1

RATIO ACCURACY:
±0.01% of input from 500 to 5000 vdc.

RATIO ACCURACY STABILITY:
±0.01% per month
±0.05% per year
} Calibrated by internal adjustment

VOLTAGE COEFFICIENT:
Less than 20 ppm total from 0 to 5000 vdc.

TEMPERATURE COEFFICIENT:
0.001%/°C

INPUT RESISTANCE:
50 Megohms

MAXIMUM INPUT VOLTAGE:
5000 vdc

REQUIRED VOLTMETER INPUT RESISTANCE:

80F-5	80F-5 (01)	80F-5 (02)
10 Megohms	11 Megohms	Infinite at null (10^3 megohms or greater)

MAXIMUM OUTPUT VOLTAGE:
5 vdc

6-7. Environmental

OPERATING:
Temperature Range – 0°C to 50°C
Humidity – 0 to 80%
Altitude Range – 0 to 10,000 feet

NON-OPERATING:
Altitude Range – 0 to 50,000 feet

6-8. Mechanical

DIMENSIONS
2.28 inches high x 1.52 inches wide x 1.525 inches deep.

WEIGHT:
20 ounces (340 grams)

6-9. OPERATING INSTRUCTIONS

a. Connect the Model 80F-5 output terminals directly to the INPUT terminals of the FLUKE voltmeter.

b. Select the appropriate dc voltage range on the FLUKE voltmeter.

c. Deenergize the high voltage source to be measured.

d. Connect the ground clip (–) and probe (+) to respective low and high sections of the high voltage source.

WARNING!

Lethal voltages will be present between the ground clip and probe of the 80F-5 when the high voltage source is energized.

e. Energize the high voltage source. Multiply the FLUKE voltmeter indication by 1000 to obtain the magnitude of the high voltage.

6-10. MAINTENANCE

6-11. General

6-12. The Model 80F-5 requires a minimum amount of maintenance. All that is required is occassional cleaning and calibration.

6-13. Cleaning

6-14. Accumulation of dust or dirt particles between the output terminals of the Model 80F-5 can be removed using clean dry pressurized air. Stubborn particles can be removed following an application of isopropyl alcohol.

6-15. Calibration

6-16. The Model 80F-5 division ratio should be checked every month or every year depending on the accuracy requirement. Ratio accuracy stability is specified at ±0.01% per month and ±0.05% per year. Calibration should be accomplished only after the Model 80F-5 has been in non-operating state for at least four hours at a temperature of 23°C.

6-17. Test equipment requirements are a stable 1000 volt dc source such as the FLUKE Model 332B Voltage Calibrator and the FLUKE voltmeter. To calibrate the Model 80F-5, perform the following steps:

NOTE

The input resistance of the voltmeter must match that of the 80F-5. See paragraph 6-6, REQUIRED VOLTMETER INPUT RESISTANCE.

a. Calibrate the FLUKE voltmeter.

b. Install the Model 80F-5 on the FLUKE voltmeter input terminals.

c. Unscrew the strain relief on the input cable of the Model 80F-5 and remove the front cover.

d. Select the appropriate dc voltage range on the FLUKE voltmeter.

e. Apply 1000 volts dc to the Model 80F-5 high voltage probe.

f. Adjust the variable resistor on the Model 80F-5 for a 1.0 volt dc indication on the FLUKE voltmeter.

g. Remove the voltage from the Model 80F-5 high voltage probe.

h. Install the Model 80F-5 front cover and strain relief.

ACCESSORY INFORMATION

MODEL 80F-15 VOLTAGE DIVIDER

6-1. INTRODUCTION

6-2. The Accessory Model 80F-15 Voltage Divider allows measurement of up to 15k volts dc to be made using FLUKE 800, 900, and 8000 series voltmeters. Division ratio of this accessory is 1000:1. Accuracy and stability of the division ratio is ensured using special metal film resistors having matched temperature coefficients.

6-3. Physical design of the Model 80F-15 allows direct mating to the input terminals of the FLUKE voltmeters. A high voltage probe facilitates connection to the measurement

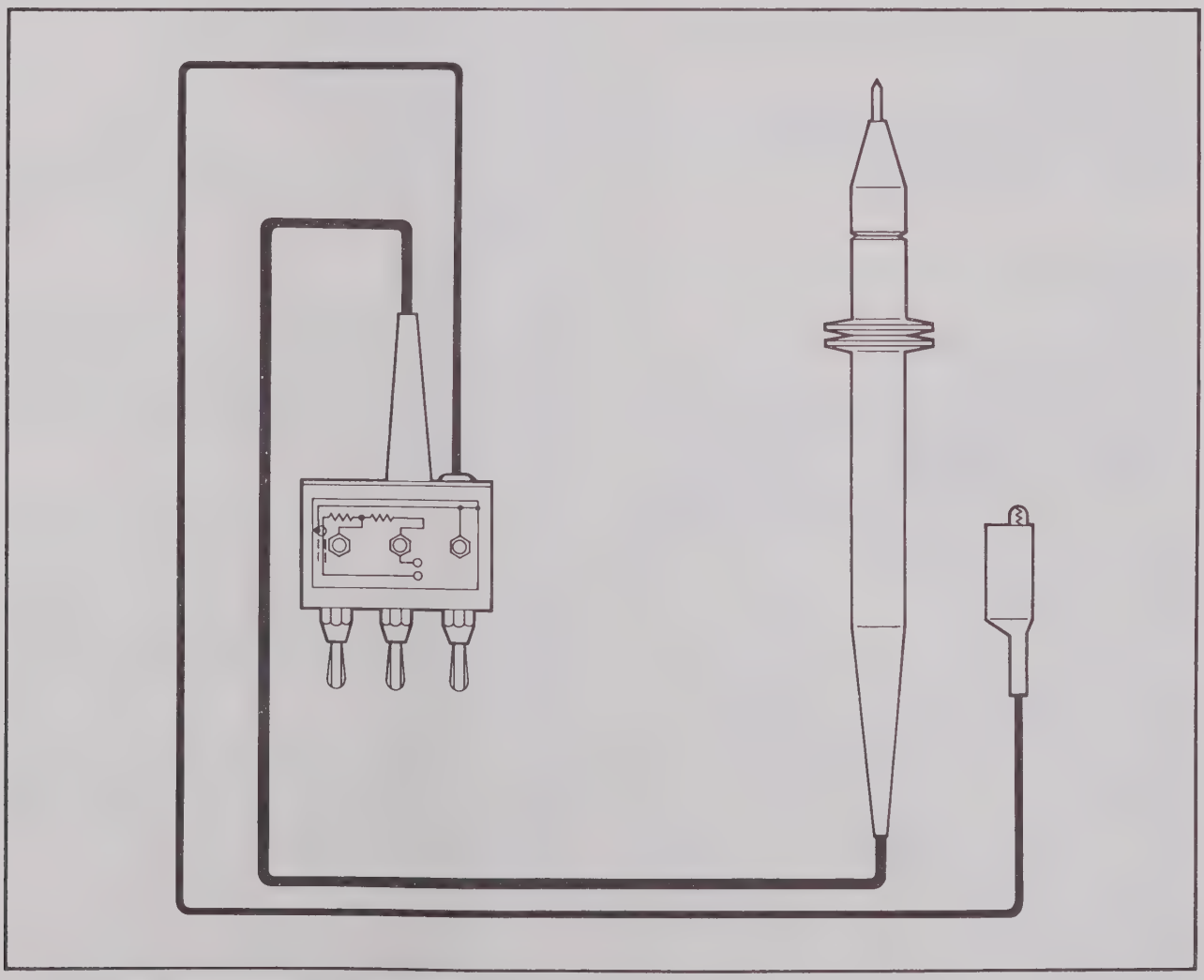


Figure 6-1. MODEL 80F-15 VOLTAGE DIVIDER

source. Maintenance is minimized by encapsulation of the divider components.

6-4. Three versions of the Model 80F-15 are available. The basic Model 80F-15 is used with voltmeters having a 10 megohm input resistance. An (01) Option is provided for voltmeters having an 11 megohm input resistance, and an (02) Option is provided for voltmeters having an infinite input resistance (10^3 megohm or greater) at null.

6-5. SPECIFICATIONS

6-6. Electrical

DIVISION RATIO:
1000:1

RATIO ACCURACY:
±0.01% of input from 1,000 to 15,000 vdc.

RATIO ACCURACY STABILITY:
±0.01% per month
±0.05% per year } Calibrated by internal adjustment

VOLTAGE COEFFICIENT:
Less than 20 ppm total from 0 to 15,000 vdc.

TEMPERATURE COEFFICIENT:
0.001%/°C

INPUT RESISTANCE:
100 Megohms

MAXIMUM INPUT VOLTAGE:
15,000 vdc

REQUIRED VOLTMETER INPUT RESISTANCE:

80F-15	80F-15 (01)	80F-15 (02)
10 Megohms	11 Megohms	Infinite at null (10^3 megohms at greater)

MAXIMUM OUTPUT VOLTAGE:
15 vdc

6-7. Environmental

OPERATING:
Temperature Range – 0°C to 50°C
Humidity – 0 to 80%
Altitude Range – 0 to 10,000 feet

NON-OPERATING:
Altitude Range – 0 to 50,000 feet

6-8. Mechanical

WEIGHT:
24 ounces (680 grams)

DIMENSIONS:
2.725 inches high x 2.69 inches wide x 1.525 inches deep.

6-9. OPERATING INSTRUCTIONS

a. Connect the Model 80F-15 output terminals directly to the INPUT of the FLUKE voltmeter.

b. Select the appropriate dc voltage range on the FLUKE voltmeter.

c. Deenergize the high voltage source to be measured.

d. Connect the ground clip (–) and probe (+) to respective low and high sections of the high voltage source.

WARNING!

Lethal voltages will be present between the ground clip and probe of the 80F-15 when the high voltage source is energized.

e. Energize the high voltage source. Multiply the FLUKE voltmeter indication by 1000 to obtain the magnitude of the high voltage.

6-10. MAINTENANCE

6-11. General

6-12. The Model 80F-15 requires a minimum amount of maintenance. All that is required is occassional cleaning and calibration.

6-13. Cleaning

6-14. Accumulation of dust or dirt particles between the output terminals of the Model 80F-15 can be removed using clean dry pressurized air. Stubborn particles can be removed following an application of isopropyl alcohol.

6-15. Calibration

6-16. The Model 80F-15 division ratio should be checked every month or every year depending on the accuracy requirement. Ratio accuracy stability is specified at ±0.01% per month and ±0.05% per year. Calibration should be accomplished only after the Model 80F-15 has been in the non-operating state for at least four hours at a temperature of 23°C.

6-17. Test equipment requirements are a stable 1000 volt dc source such as the FLUKE Model 332B Voltage Calibrator and the FLUKE voltmeter. To calibrate the Model 80F-15, perform the following steps:

NOTE

The input resistance of the voltmeter must match that of the 80F-15. See paragraph 6-6, REQUIRED VOLTMETER INPUT RESISTANCE.

a. Calibrate the FLUKE voltmeter.

b. Install the Model 80F-15 on the FLUKE voltmeter input terminals.

c. Unscrew the strain relief on the input cable of the Model 80F-15 and remove the front cover.

d. Select the appropriate dc voltage range on the FLUKE voltmeter.

e. Apply 1000 volts dc to the Model 80F-15 high voltage probe.

f. Adjust the variable resistor on the Model 80F-15 for a 1.0 volt dc indication on the FLUKE voltmeter.

g. Remove the voltage from the Model 80F-15 high voltage probe.

h. Install the Model 80F-15 front cover and strain relief.

ACCESSORY INFORMATION

MODEL 80-RF HIGH FREQUENCY PROBE

6-1. INTRODUCTION

62. The Model 80-RF High Frequency Probe allows measurements over a frequency range of 100 kHz to 500 MHz from 0.25 to 30 volts when using FLUKE voltmeters having an input impedance of 10 megohms ±10%. The accuracy of measurement is ±5% from 100 kHz to 100 MHz and +7% to 500 MHz. The probe operates into any dc voltmeter having an input impedance of 10 megohms ±10%. A shielded dual-banana plug on the probe permits direct connection to the voltmeter input.

6-3. SPECIFICATIONS

6-4. Electrical

VOLTAGE 0.25V to 30V

RESPONSE: Responds to peak value of input. Calibrated to read rms value of a sine wave input.

AC TO DC TRANSFER ACCURACY:
Loaded with 10 megohms ±10%.

	100 KHz – 100 MHz	100 MHz – 500 MHz
+10°C to +30°C	±5%	±7%
–10°C to +40°C	±7%	±15%

<±3 db at 10 kHz and 700 MHz.

INPUT IMPEDANCE: 4 megohms shunted by 2 ±0.5 pf.

MAXIMUM INPUT: 30 volts rms AC, 200 volts DC.

6-5. General

CABLE CONNECTIONS: Shielded dual banana plug
Fits all standard 3/4-inch dual banana connectors.

CABLE LENGTH: 4 ft(121.9 cm) minimum.

WEIGHT: 3-½ oz. net.

ACCESSORIES SUPPLIED
Ground Lead
Straight Tip
Hook Tip
High Frequency Adapter .

6-6. OPERATING INSTRUCTIONS

6-7. Connect the shielded dual banana plug directly to the voltmeter input terminals, GND to COMMON or LO. Affix the appropriate probe tip to the probe body, then connect the probe to the high frequency circuit under test. When using the Straight or Hook Tip the ground clip must be connected to the test circuit. When using the high frequency adaptor with appropriate 50 ohm connectors, the ground clip is not required.

6-8. The Straight Tip or Hook Tip supplied with the probe can be used for measurements up to 100 MHz. For measurements above 100 MHz the High Frequency Adapter allows connections to 50 ohm terminations. Ensure that the probe is used in conjunction with dc voltmeters having 10 MΩ ±10% input impedance to meet its specifications.

6-9. The maximum input to the probe is 30 volts rms ac, or 200 volts dc. These factors may be used in combination so that an ac signal may be measured riding on a dc voltage of up to 200 volts. However, it must be noted that if ac superimposed on dc is being measured, the dc level must not be changed by more than 200 volts or the resulting transient is apt to damage the diodes inside the probe.

6-10. THEORY OF OPERATION

6-11. Figure 6-1 contains a schematic diagram of the probe. C1 is a dc blocking capacitor, CR1 is used as a detector, and R1, R3, CR2, R2, and Rin form a divider network. C1, charging through CR1 during the negative half cycle of the input produces a positive dc voltage at the CR1-R1 junction which equals the negative peak value of the input signal. The divider network reduces this to the rms value of the input. It can be seen that the probe must be operated into a 10 MΩ load in order to maintain the proper division ratio.

6-12. CR2 provides compensation for the non-linearity of the detector. R3 is a selected part having a value of 50 kΩ to 100 kΩ, as required for proper divider action.

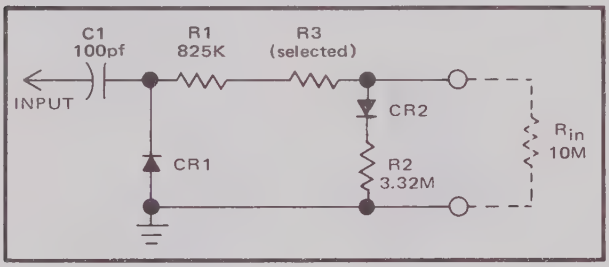


Figure 6-1. SCHEMATIC

6-13. MAINTENANCE

6-14. Performance Checks

6-15. The following checks verify the probe AC to DC Transfer accuracy.

6-16. LOW FREQUENCY RESPONSE. Connect equipment as shown in Figure 6-2, and perform the following steps.

a. With equipment as shown in connection "A" adjust the ac signal source for an output of 3.000 volts rms at 100 kHz as measured on the DVM.

b. In connection "B" with the DVM set to measure dc, observe a probe output of 3.15 to 2.85 volts.

c. Placing cables back in connection "A", decrease the ac signal source by 10db (0.95 volts).

d. Moving back to connection "B", observe a voltmeter indication of between 1.00 and 0.90 volts (10 db down from 3 volts).

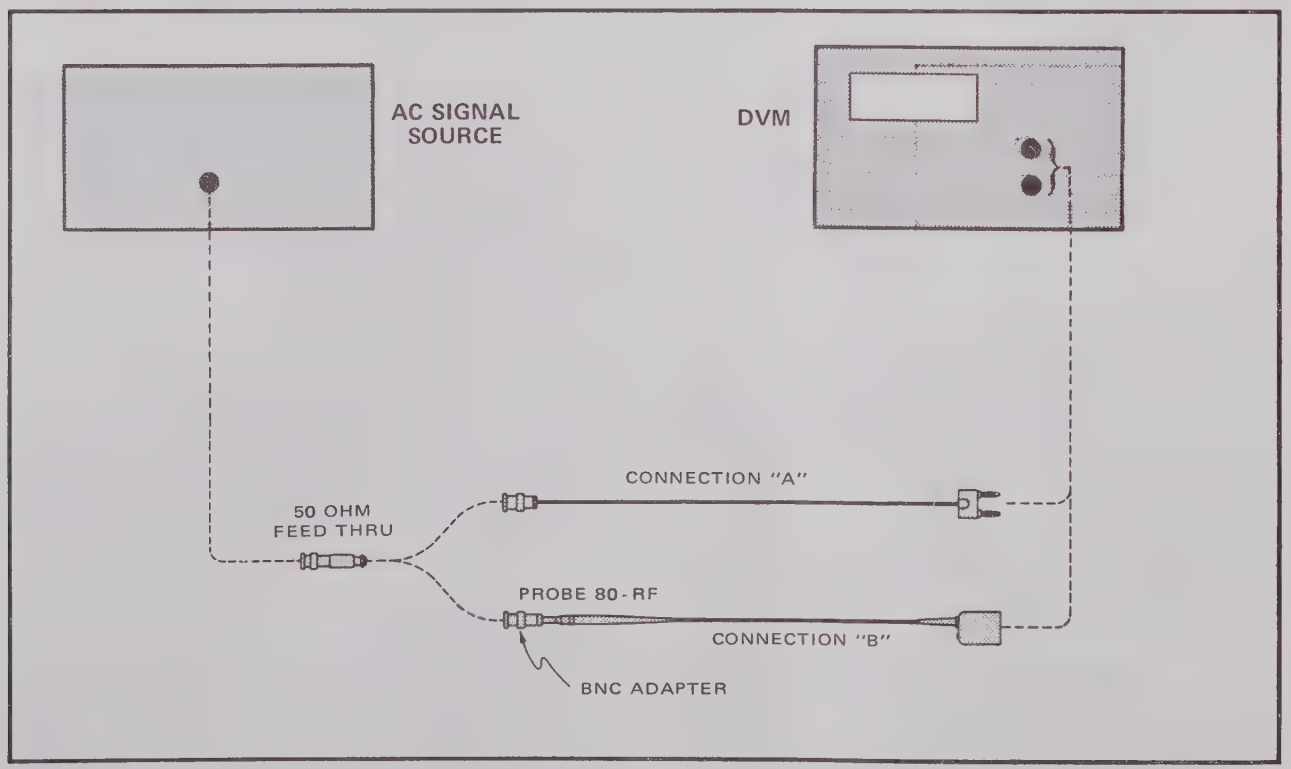


Figure 6-2. LOW FREQUENCY RESPONSE CHECK

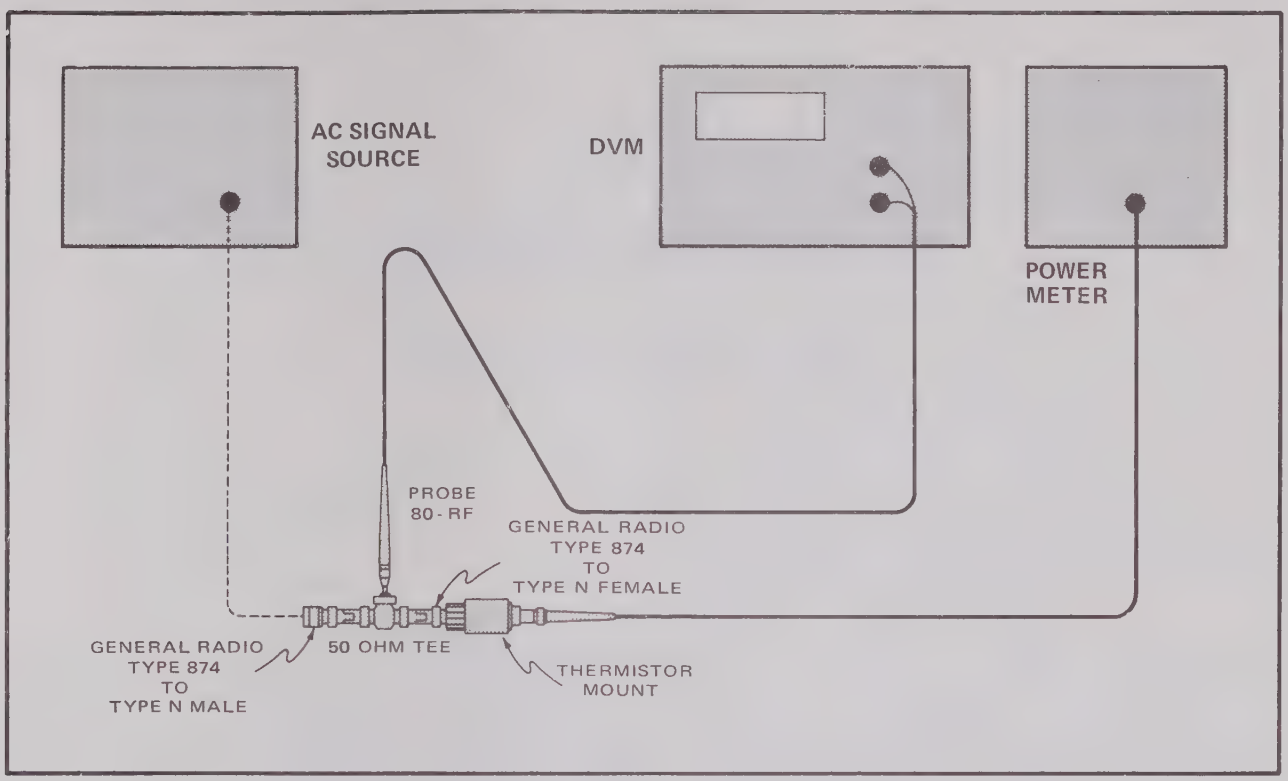


Figure 6-3. HIGH FREQUENCY RESPONSE CHECK

e. In connection "A", decrease the ac signal source an additional 10 db (to 0.3 volts) as indicated by the voltmeter in its ac function.

f. Back to "B", observe a voltmeter reading of .315 to .285 vdc.

g. Return the ac signal source back to 3.000 vrms.

h. Repeat steps a through g with frequencies of 500 kHz, 1 MHz, and 10 MHz.

6-17. HIGH FREQUENCY RESPONSE. Connect equipment to the 80-RF probe as shown in Figure 6-3, and perform the following steps:

a. Set the ac signal source ot 100 MHz with an output level of 10 milliwatts as indicated on the power meter. Ensure that the ac signal source has stabilized at 10 millivolts output.

b. Observe that the voltmeter indication is between 0.757 and 0.657 volts. (0.707 volts corresponds to 10 milliwatts in 50 ohms).

c. Repeat the above for frequencies of 200 MHz, 300 MHz, 400 MHz, and 480 MHz.

6-18. Calibration

6-19. Should the 80-RF require recalibration, perform the following steps:

a. Perform steps a and b in paragraph 6-16, with a frequency of 1 MHz.

b. Observe the dc voltmeter indication; a reading below 3 volts calls for a decrease in the value of R3, a reading above 3 volts calls for an increase in R3. Resistor R3 should be a 1/8 W metal film type. In a probe that is working properly, a 30 kΩ change in R3 will produce about a 1% reading deviation.

6-20. Cleaning

6-21. The Model 80-RF requires a minimum amount of cleaning. Accumulation of dust or dirt particles between the output terminals of the Model 80-RF can be removed using clean dry pressurized air. Stubborn particles can be removed following an application of isopropyl alcohol.

ACCESSORY INFORMATION

MODEL A90 CURRENT SHUNT

6-1. INTRODUCTION

6-2. The Model A90 Current Shunt is designed for use with any high-impedance ac or dc voltmeter capable of accurately measuring 100 millivolts. Six Fluke precision wire wound and strip resistors provide a 100 millivolt full-scale output for each of six pushbutton current ranges: 0.1, 1, 10, 100, and 1000 milliamperes and 10 amperes (ac or dc). Basic accuracy is specified over a frequency range of dc to 4 kHz for the 10 ampere range and dc to 10 kHz for the milliampere ranges.

6-3. The instrument is supplied in half-rack case so that it may be conveniently mounted side-by-side with other half-rack instruments in a standard 19-inch rack. A carrying handle detents into custom non-marring feet and serves as a tilt-up bail for bench use.

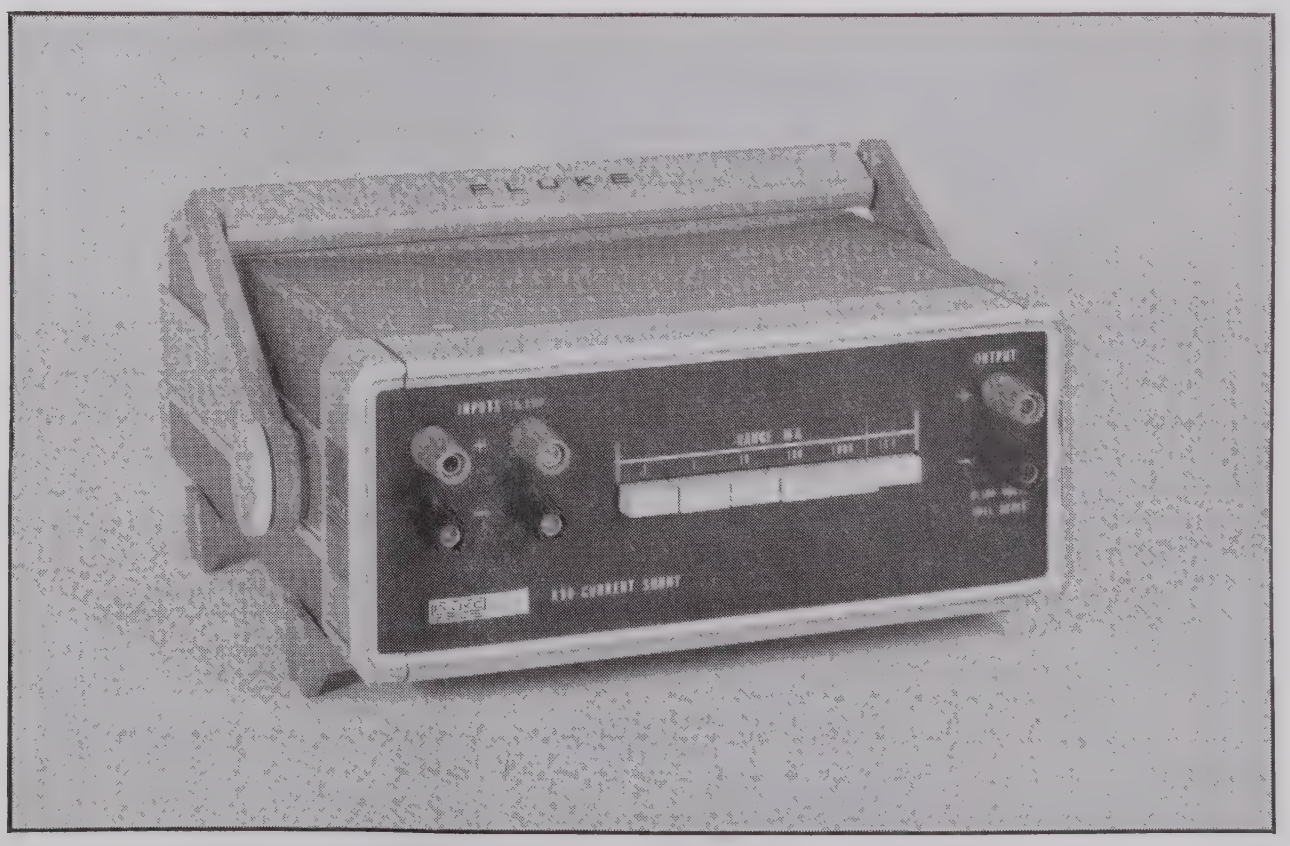
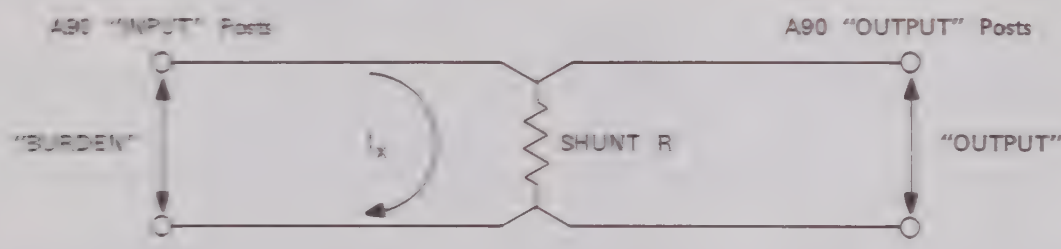


Figure 6-1. MODEL A90 CURRENT SHUNT

Table 6-1. ACCURACY OF A90 (1 year, 15°C - 35°C)

RATED CURRENT RANGE	E BURDEN (APPROX.)	SHUNT R	"OUTPUT" AT RATED CURRENT	"OUTPUT" ACCURACY AS % OF CURRENT INPUT	
				DC ONLY	DC TO 10 KHZ AC
0.1 ma	100 mv	1 kΩ	100 mv	±0.1%	±0.1%
*0.1 ma	100 mv	1 kΩ	100 mv	+0.0% −0.2%	+0.0% −0.2%
1.0 ma	100 mv	100Ω	100 mv	±0.1%	±0.1%
10 ma	100 mv	10Ω	100 mv	±0.1%	±0.1%
100 ma	102 mv	1Ω	100 mv	±0.1%	±0.1%
1A	120 mv	0.1Ω	100 mv	±0.1%	±0.2%
10A	300 mv	0.01Ω	100 mv	±0.2%	±0.3% (to 4 kHz)

*With 1 MΩ Input R Voltmeter.
When Input R is ≥10 MΩ, use non-asterisked 0.1 ma specification.



Simplified diagram illustrating terms used in table.

6-4. SPECIFICATIONS

6-5. Electrical

RANGE
0.1, 1, 10, 100, and 1000 milliamps and 10 amperes.

ACCURACY
Table 6-1 gives accuracy specifications for the Model A90 only. Total current measurement accuracy is also dependent on the accuracy and input impedance of the voltmeter being used.

SENSITIVITY
100 millivolts full scale.

OVERLOAD
Model A90 will not be damaged by 100% overload on each range below 10 amperes or by 50% overload on the 10 ampere range.

6-6. Mechanical

CURRENT SELECTION
Pushbutton, each range.

CONNECTORS
Positive (+) and negative (−) INPUT and OUTPUT binding posts with separate input posts for 10 ampere range.

DIMENSIONS
The Model A90 outline drawing is shown in Figure 6-2.

RACK MOUNTING KITS (OPTIONAL)
MEE-7014: Side-by-side Half-rack Mounting Kit
MEE-7006: Center Rack Mounting Kit
MEE-7013: Left or right of center Mounting Kit.

6-7. AUXILIARY ELECTRICAL SPECIFICATIONS

6-8. Tables 6-2 through 6-6 provide accuracy specifications for the Model A90 when used with Fluke Models

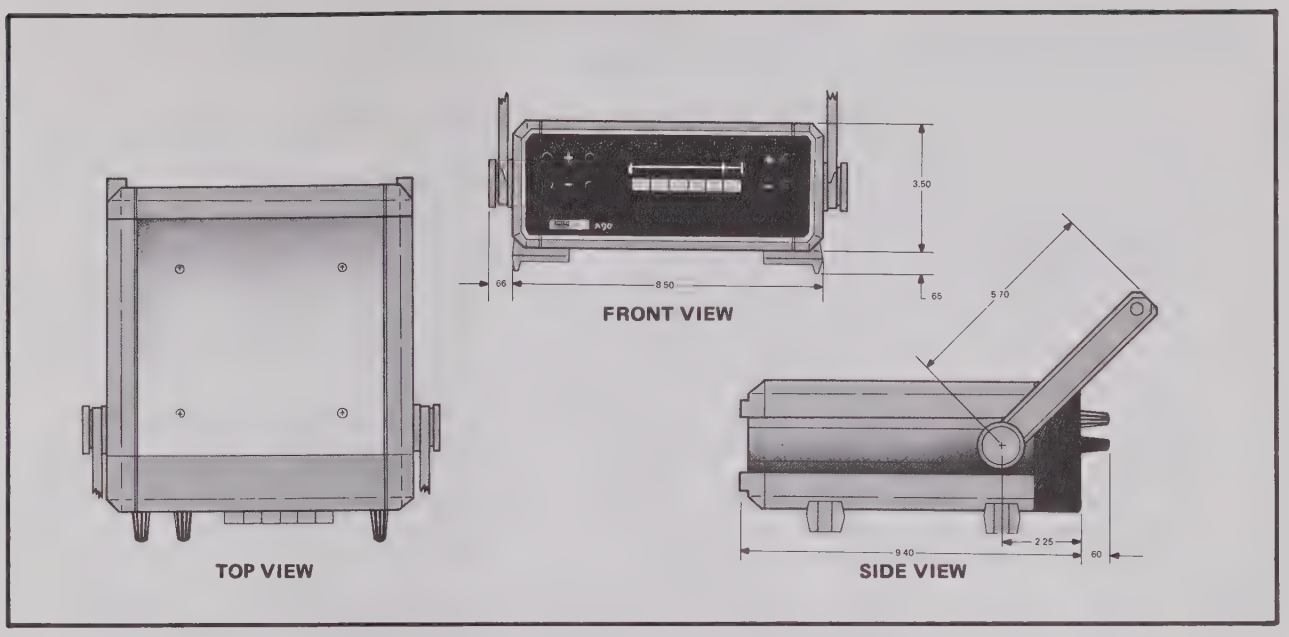


Figure 6-2. MODEL A90 OUTLINE DRAWING

Table 6-2. A90/8100A ACCURACY. 30 days, @ 23°C ±5°C.

DC ACCURACY	
CURRENT RANGE	SPECIFICATION
0.1 ma	±(0.12% of current input + 0.1 ua)
1.0 ma	±(0.12% of current input + 1.0 ua)
10 ma	±(0.12% of current input + 10 ua)
100 ma	±(0.12% of current input + 0.1 ma)
1A	±(0.12% of current input + 1.0 ma)
10A	±(0.22% of current input + 10 ma)

AC ACCURACY		
CURRENT RANGE	30 Hz – 50 Hz	50 Hz – 10 kHz
0.1 ma	+(0.5% of current input + 1.0 ua) –(0.7% of current input + 1.0 ua)	+(0.2% of current input + 0.5 ua) –(0.4% of current input + 0.5 ua)
1.0 ma	±(0.6% of current input + 10 ua)	±(0.3% of current input + 5.0 ua)
10 ma	±(0.6% of current input + 0.1 ma)	±(0.3% of current input + 50 ua)
100 ma	±(0.6% of current input + 1.0 ma)	±(0.3% of current input + 0.5 ma)
1A	±(0.7% of current input + 10 ma)	±(0.4% of current input + 5.0 ma)
10A	±(0.8% of current input + 100 ma)	±(0.5% of current input + 50 ma)*

*10A specified to 4 kHz only.

For:	DC CURRENT	AC CURRENT
	V_r = 1v	V_r = 1v
	V_{dfs} = ±.1000	V_{dfs} = .1000

Table 6-3. A90/8300A ACCURACY

DC CURRENT ACCURACY

MEASUREMENTS WITHOUT MV/OHMS OPTION INSTALLED

CURRENT RANGE	24 hr @ 23°C ±1°C	90 days @ 23°C ±5°C
0.1 ma	±(0.1% of current input + 0.1 ua)	±(0.11% of current input + 0.3 ua)
1.0 ma	±(0.1% of current input + 1.0 ua)	±(0.11% of current input + 3.0 ua)
10 ma	±(0.1% of current input + 10 ua)	±(0.11% of current input + 30 ua)
100 ma	±(0.1% of current input + 0.1 ma)	±(0.11% of current input + 0.3 ma)
1A	±(0.1% of current input + 1.0 ma)	±(0.11% of current input + 3.0 ma)
10A	±(0.2% of current input + 10 ma)	±(0.21% of current input + 30 ma)

V_r = 10 VDC

V_{dfs} = 0.1000 (Readout also will display "DC +" or "DC −").

MEASUREMENTS WITH MV/OHMS OPTION (8300A-02) INSTALLED

CURRENT RANGE	90 days @ 23°C ±5°C
0.1 ma	±(0.11% of current input + 0.01 ua)
1.0 ma	±(0.11% of current input + 0.1 ua)
10 ma	±(0.11% of current input + 1.0 ua)
100 ma	±(0.11% of current input + 10 ua)
1A	±(0.11% of current input + 0.1 ma)
10A	±(0.21% of current input + 1.0 ma)

V_r = 100 MV (0.1v)

V_{dfs} = 100.000 (Readout will also display MV DC + or MV DC−)

AC CURRENT ACCURACY

MEASUREMENTS WITH AC OPTION 8300A-01 INSTALLED

90 days @ 23°C ±5°C using AC Zero control periodically.

CURRENT RANGE	30 Hz – 50 Hz	50 Hz – 10 kHz
0.1 ma	+(0.5% of current input + 0.05 ua) −(0.7% of current input + 0.05 ua)	+(0.1% of current input + 0.05 ua) −(0.3% of current input + 0.05 ua)
1.0 ma	±(0.6% of current input + 0.5 ua)	±(0.2% of current input + 0.5 ua)
10 ma	±(0.6% of current input + 5.0 ua)	±(0.2% of current input + 5.0 ua)
100 ma	±(0.6% of current input + 50 ua)	±(0.2% of current input + 50 ua)
1A	±(0.7% of current input + 0.5 ma)	±(0.3% of current input + 0.5 ma)
10A	±(0.8% of current input + 5.0 ma)	±(0.4% of current input + 5.0 ma)*

V_r = 1 VAC

V_{dfs} = .10000 (Readout will also display "AC")

*10A specified to 4 kHz only.

Table 6-4. A90/9500A SPECIFICATIONS

ACCURACY WHEN UNKNOWN CURRENT IS 20% OR MORE OF A90 CURRENT RANGE. (23°C ±1°C)

CURRENT RANGE	20 Hz – 50 Hz	50 Hz – 10 kHz
0.1 ma	+(0.3% of current input + 0.02 ua) –(0.5% of current input + 0.02 ua)	+(0.05% of current input + 0.015 ua) –(0.25% of current input + 0.015 ua)
1.0 ma	±(0.4% of current input + 0.2 ua)	±(0.15% of current input + 0.15 ua)
10 ma	±(0.4% of current input + 2.0 ua)	±(0.15% of current input + 1.5 ua)
100 ma	±(0.4% of current input + 20 ua)	±(0.15% of current input + 15 ua)
1A	±(0.5% of current input + 0.2 ma)	±(0.25% of current input + 0.15 ma)
10A	±(0.6% of current input + 2.0 ma)	±(0.35% of current input + 1.5 ma)*

ACCURACY WHEN UNKNOWN CURRENT IS BETWEEN 10% AND 20% OF A90 CURRENT RANGE.

A90 INPUT (% OF CURRENT RANGE)	% OF INPUT ABSOLUTE ACCURACY 20 Hz – 50 Hz @ 23°C ±1°C FOR A90 CURRENT RANGE				
	0.1 ma				
	+	–	1 ma – 100 ma	1A	10A
10-11%	0.53%	0.73%	± 0.63%	±0.73%	±0.83%
12-14%	0.50%	0.70%	± 0.60%	±0.70%	±0.80%
15-17%	0.47%	0.67%	± 0.57%	±0.67%	±0.77%
18-20%	0.44%	0.64%	± 0.54%	±0.64%	±0.74%

A90 INPUT (% OF CURRENT RANGE)	% OF INPUT ABSOLUTE ACCURACY 50 Hz – 10 kHz @23°C ±1°C FOR A90 CURRENT RANGE				
	0.1 ma				
	+	–	1 ma – 100 ma	1A	10A*
10-11%	0.23%	0.43%	±0.33%	±0.43%	±0.53%
12-14%	0.20%	0.40%	±0.30%	±0.40%	±0.50%
15-17%	0.17%	0.37%	±0.27%	±0.37%	±0.47%
18-20%	0.13%	0.33%	±0.23%	±0.33%	±0.43%

V_r = .1v

V_{dfs} = .10000

TC = 0.005% of current input/°C 20 Hz –50 Hz
0.004% of current input/°C 50 Hz – 10 kHz

*10A is specified to 4 kHz only.

8100A, 8300A, 9500A, 891A, 893A, and 931B. Table 6-7 gives V_r and V_{dfs} for each of the voltmeters listed in the tables in addition to various other Fluke voltmeters, where

V_r = Voltage range to be used on the voltmeter
and V_{dfs} = Nominal voltmeter reading with full-scale current in A90 shunt.

6-9. INSTALLATION

6-10. There are three rack-mount kits available, at additional cost, for use with the Model A90. Kit MEE-7014 allows the Model A90 to be mounted side-by-side with another half-rack instrument in a standard 19-inch rack. Kit MEE-7006 supplies hardware necessary to mount the

Table 6-5. A90/891A AND 893A ACCURACY (Sheet 1 of 2)

WITH 891A AND 893A – DC ACCURACY		
CURRENT RANGE	@ 23°C ±2°C	@ 15°C –35°C
0.1 ma	±(0.11% of current input + 0.02 ua)	±(0.12% of current input + 0.02 ua)
1.0 ma	±(0.11% of current input + 0.2 ua)	±(0.12% of current input + 0.2 ua)
10 ma	±(0.11% of current input + 2.0 ua)	±(0.12% of current input + 2.0 ua)
100 ma	±(0.11% of current input + 20 ua)	±(0.12% of current input + 20 ua)
1A	±(0.11% of current input + 0.2 ma)	±(0.12% of current input + 0.2 ma)
10A	±(0.21% of current input + 2.0 ma)	±(0.22% of current input + 2.0 ma)
V_r = 1v V_{dfs} = 0.10000		

WITH 893A – AC ACCURACY @ 23°C ±2°C	
CURRENT RANGE	50 Hz – 10 kHz
0.1 ma	+(0.05% of current input + 0.025 ua) –(0.25% of current input + 0.025 ua)
1.0 ma	±(0.15% of current input + 0.25 ua)
10 ma	±(0.15% of current input + 2.5 ua)
100 ma	±(0.15% of current input + 25 ua)
1A	±(0.25% of current input + 0.25 ma)
10A	±(0.35% of current input + 2.5 ma)*

WITH 893A – AC ACCURACY @ 15°C –35°C		
CURRENT RANGE	5 Hz – 10 Hz	10 Hz – 20 Hz
0.1 ma	+(1.0% of current input + 0.25 ua) –(1.2% of current input + 0.25 ua)	+(0.5% of current input + 0.1 ua) –(0.7% of current input + 0.1 ua)
1.0 ma	±(1.1% of current input + 2.5 ua)	±(0.6% of current input + 1.0 ua)
10 ma	±(1.1% of current input + 25 ua)	±(0.6% of current input ± 10 ua)
100 ma	±(1.1% of current input + 0.25 ua)	+(0.6% of current input + 0.1 ma)
1A	±(1.2% of current input + 2.5 ma)	±(0.7% of current input + 1.0 ma)
10A	±(1.3% of current input + 25 ma)	±(0.8% of current input + 10 ma)

893A – AC ACCURACY @ 15°C –35°C.		
CURRENT RANGE	20 Hz – 50 Hz	50 Hz – 10 kHz
0.1 ma	+(0.15% of current input + 0.025 ua) –(0.35% of current input + 0.025 ua)	+(0.1% of current input + 0.025 ua) –(0.3% of current input + 0.025 ua)
1.0 ma	±(0.25% of current input + 0.25 ua)	±(0.2% of current input + 0.25 ua)
10 ma	±(0.25% of current input + 2.5 ua)	±(0.2% of current input + 2.5 ua)
100 ma	±(0.25% of current input + 25 ua)	±(0.2% of current input + 25 ua)
1A	±(0.35% of current input + 0.25 ma)	±(0.3% of current input + 0.25 ma)
10A	±(0.45% of current input + 2.5 ma)	±(0.4% of current input + 2.5 ma)*

Table 6-5. A90/891A AND 893A ACCURACY (Sheet 2 of 2)

V_r = 1v (AC or DC) V_{dfs} = 0.10000 *10A is specified to 4 kHz only.

Table 6-6. A90/931B SPECIFICATIONS

ACCURACY WHEN UNKNOWN CURRENT IS 10% OR MORE OF A90 CURRENT RANGE				
CURRENT RANGE	% OF INPUT ABSOLUTE ACCURACY 2 Hz – 3 Hz	3 Hz – 5 Hz	5 Hz – 30 Hz	SPECIFICATIONS 30 Hz – 10 kHz
0.1 ma	+1.0% –1.2%	+0.5% –0.7%	+0.2% –0.4%	+(0.05% of current input + 5 na) –(0.25% of current input + 5 na)
1.0 ma	±1.1%	±0.6%	±0.3%	±(0.15% of current input + 50 na)
10 ma	±1.1%	±0.6%	±0.3%	±(0.15% of current input + 0.5 ua)
100 ma	±1.1%	±0.6%	±0.3%	±(0.15% of current input + 5 ua)
1A	±1.2%	±0.7%	±0.4%	±(0.25% of current input + 50 ua)
10A	±1.3%	±0.8%	±0.5%	±(0.35% of current input + 0.5 ma)*
TC=	±0.1%/°C	±0.05%/°C	±0.025%/°C	±0.0025%/°C
V_r = 100 MV V_{dfs} = 100.000 *10A is specified to 4 kHz only.				

Table 6-7. "V_r" AND "V_{dfs}" FOR VOLTMETERS OF TABLES 6-2 THROUGH 6-6

VOLTMETER	"V_r"	"V_{dfs}"
8300A (Without MV/Ohms)	10v	.010
8100A, 871A, 873A, 881A, 883A, 885A, 887A, 891A, 893A	1v	.100
801, 803, 801B, 803B, 803D, 821A, 823A, 825A	0.5v	.100
9500A, 910A	0.1v	.100
8300A (With MV/Ohms), 931A, 931B	100 MV	100.0

V_r = Voltage range to be used on the voltmeter.
V_{dfs} = Nominal voltmeter reading with full-scale current in A90 shunt.

instrument in the center of the rack. Kit MEE-7013 supplies two different sized rack ears so that the instrument can be mounted to the left or to the right of rack center.

6-11. OPERATING INSTRUCTIONS

6-12. A description of Model A90 controls and terminals is given in Figure 6-3.

6-13. Equipment Connections

6-14. It is recommended that the Model A90 always be used in the "LO" lead as shown in Figure 6-4A. When used in the "HI" lead, as shown in Figure 6-4B, the distributed capacitance, C_{DIST}, loads the source. When connected in the "HI" lead, the voltmeter guard should either be connected as shown or else the voltmeter should be battery operated.

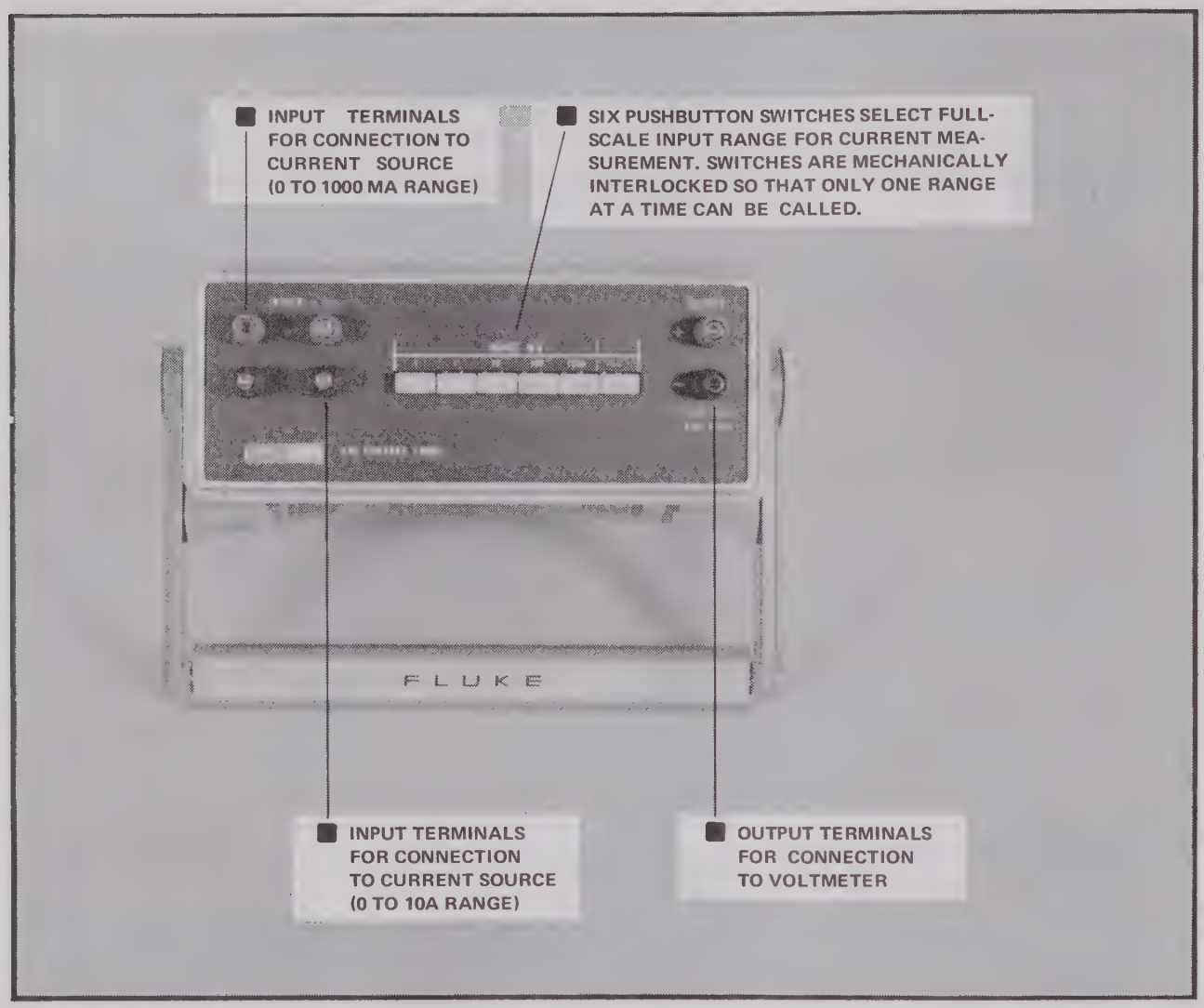

INPUT TERMINALS FOR CONNECTION TO CURRENT SOURCE (0 TO 1000 MA RANGE)
SIX PUSHBUTTON SWITCHES SELECT FULL-SCALE INPUT RANGE FOR CURRENT MEASUREMENT. SWITCHES ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE RANGE AT A TIME CAN BE CALLED.
FLUKE
INPUT TERMINALS FOR CONNECTION TO CURRENT SOURCE (0 TO 10A RANGE)
OUTPUT TERMINALS FOR CONNECTION TO VOLTMETER

Figure 6-3. MODEL A90 CONTROLS AND TERMINALS.

6-15. At high ac currents, performance of the A90 may depend upon the manner in which the current leads are connected to the input binding posts. Optimum performance is obtained when the input current leads are twisted.

6-16. Voltmeter Impedance

6-17. The input impedance of the voltmeter which is used with the Model A90 is significant with regard to total measurement accuracy. As indicated in the specifications, Model A90 measurement accuracy is derated for voltmeters having finite input impedance. As the voltmeter input capacity increases, the Model A90 response rolls off at the high end; and as the voltmeter input resistance decreases, the response shifts downward, resulting in negative measurement errors.

6-18. Combining Model A90 And Voltmeter Specifications

6-19. Combined specifications for the A90 when used with various Fluke voltmeters is given in Tables 6-2 through 6-6. When the A90 is used with other voltmeters, the following information may be used to combine specifications.

6-20. Equation 1 (Figure 6-5) is used to combine A90 and voltmeter specifications for overall accuracy. The "W" term is taken from Table 6-1, and the "X", "Y" and "Z" terms are taken from voltmeter specifications (data sheets). All Fluke voltmeter specifications, except the Model 910A, contain the "X" term; they usually list the "Y" term and occasionally the "Z" term. Model 910A accuracy specifi-

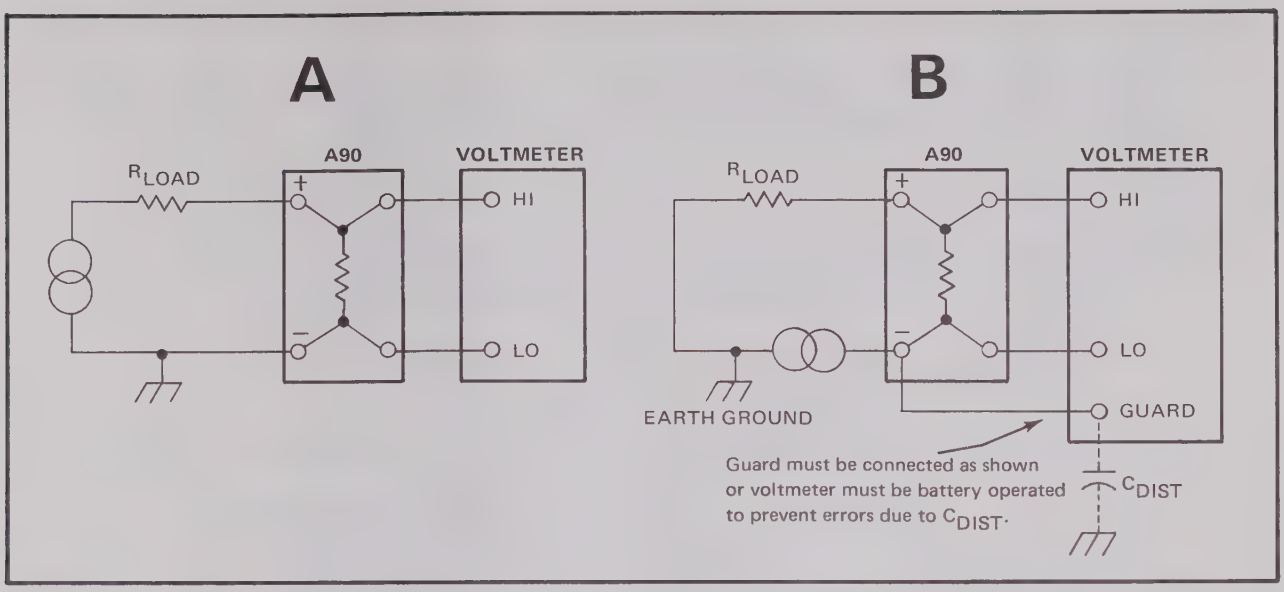


Figure 6-4. EQUIPMENT CONNECTIONS FOR CURRENT MEASUREMENT.

EQUATION 1. COMBINING A-90 SPECIFICATION WITH VOLTMETER SPECIFICATION.

A-90 Specification (from Table 6-1)

Voltmeter Specification (from Voltmeter Data Sheet)

$$\pm \mid W \mid \% \qquad \pm (\mid X \mid \% \text{ of input} + \mid Y \mid \% \text{ of range} + \mid Z \mid \text{uv})$$

Vr = Lowest voltmeter range that will measure 100 MV

$$= + \left[(W + X) \% \text{ of current input} + \frac{Vr}{0.1} \times \left(Y + \frac{Z}{10000} \right) \% \text{ of current range} \right]$$

EXAMPLE 1: Accuracy using 10 ma DC A-90 range with 891A.

A-90 Specification (from Table 6-1)

891A Specification (from 891A Data Sheet)

$$\pm \mid 0.1 \mid \% \qquad \pm (\mid 0.01 \mid \% \text{ of input} + \mid 0.001 \mid \% \text{ of range} + \mid 10 \mid \text{uv})$$

Vr = 1.0 (891A's 1v DC Range)

$$= \pm \left[(0.1 + 0.01) \% \text{ of current input} + \frac{1.0}{0.1} \times \left(0.001 + \frac{10}{10{,}000} \right) \% \text{ of current range} \right]$$

$$= \pm \left[0.11\% \text{ of current input} + 0.02\% \text{ of current range} \right]$$

$$= \pm \left[0.11\% \text{ of current input} + 2 \text{ ua} \right]$$

Figure 6-5. EQUATION 1 – COMBINING A90 AND VOLTMETER SPECIFICATIONS (Sheet 1 of 2)

EXAMPLE 2: Accuracy using 0.1 ma AC A-90 range with 873A at 1 kHz.

Model 873A has 1 megohm input impedance in its AC mode so separate accuracy statements are required for positive and negative limits of error for measurements made on the A-90's 0.1 ma range.

Positive Limit of Error

A-90 Specification: + | 0.0 | %

873A Specification: ± | 0.2 | % of input + | 25 | uv

"Vr" is 873A's 1v AC Range

No "Y" Term In Spec.

$$= +\left[(0.0 + 0.2)\ \%\ \text{of current input} + \frac{1}{0.1} \times \left(0 + \frac{25}{10000}\right)\ \%\ \text{of current range}\right]$$

$$= +\left[\ 0.2\%\ \text{of current input} + 0.025\%\ \text{of current range}\ \right]$$

Negative Limit of Error

$$= -\left[\ (0.2 + 0.2)\ \%\ \text{of current input} + 0.025\%\ \text{of current range}\ \right]$$

$$= -\left[\ 0.4\%\ \text{of current input} + 0.025\%\ \text{of current range.}\ \right]$$

Figure 6-5. EQUATION 1 – COMBINING A90 AND VOLTMETER SPECIFICATIONS (Sheet 2 of 2)

cation consists of "Y" term only. If "X", "Y", or "Z" do not appear in a voltmeter accuracy specification, it should be treated as a zero in Equation 1. The voltmeter must be used on the lowest range that can measure 100 millivolts. This range is assigned the symbol "V_r" in Equation 1. V_r is always stated as volts, i.e., 100 millivolt range equals 0.1 volts for V_r .

6-21. Equation 2 (Figure 6-6) may be used to convert the voltmeter voltage reading to current.

6-22. THEORY OF OPERATION

6-23. The schematic diagram of the Model A90 is located at the back of the manual. In the milliampere ranges, current is directed through the appropriate shunt resistor by switches S1A through S5A, and the corresponding output voltage is connected to the output terminals through switches S1 through S5, decks B and C. In 10 ampere range, the input current is applied directly to the shunt resistor, and the output voltage is connected to the output terminals through switch S6.

6-24. All shunt resistors are four-terminal shunts or are connected in a four-terminal switching arrangement so that lead resistance does not affect measurement accuracy.

6-25. MAINTENANCE

6-26. The following paragraphs contain instructions for cleaning and calibrating the Model A90.

6-27. Cleaning

6-28. The instrument should be cleaned periodically to remove dust, grease, and other contamination. The following procedure should be adhered to when cleaning the instrument:

a. Remove loose contamination with low-pressure, clean, dry air.

b. Clean front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened in a mild solution of detergent and water.

CAUTION!

Do not use aromatic hydrocarbons or chlorinated solvents on the front panel, because they will react with the Lexan binding posts.

$$I_x = I_r \times \frac{V_d}{V_{dfs}}$$

Where:
- I_x = magnitude of unknown current in units of A90 "RANGE" used. (i.e. ma or amps).
- I_r = A90 Rated Current "RANGE".
- V_d = Voltmeter reading.
- V_{dfs} = Nominal Voltmeter reading with rated current flowing in A90. "V_{dfs}" and "V_r" are tabulated in Table 6-7 for each voltmeter listed in Tables 6-2 through 6-6. Note that "V_{dfs}" multiplies or divides "V_d" by powers of 10 so it is simple to manipulate.

EQUATION 2. CONVERTING VOLTAGE READINGS TO CURRENT

Example: An 8100A reads =.0643 when used with an A90 in the 10 ma range. What current is flowing?

- I_r = 10 ma (A90 "Rated Current Range")
- V_d = .0643 (Voltmeter reading)
- V_{dfs} = .1000 (From Table 6-7)

Answer: $I_x = 10 \text{ ma} \times \frac{.0643}{.1000} = 6.43 \text{ ma}$

Figure 6-6. Equation 2 – CONVERTING VOLTAGE READINGS TO CURRENT

6-29. Test Equipment

6-30. Test equipment required for calibration and testing of the Model A90 is shown in Table 6-8. If the recommended equipment is not available, other equivalent equipment may be used.

Table 6-8. LIST OF TEST EQUIPMENT

NAME	RECOMMENDED EQUIPMENT
Constant Current Source	Fluke Model 382A
DC Differential Voltmeter	Fluke Model 895A or 885A
Low-Thermal Leads	
4-Terminal Ohmmeter	Fluke Model 8300A with Option -02

6-31. Calibration

6-32. PRELIMINARY CHECKS. Make the resistance checks shown in Table 6-9. Values are approximate since check is intended to show only gross errors, such as defective or open resistors.

6-33. .1 MA AND 1 MA RANGE CHECKS. Connect the ohmmeter and A90, as shown in Figure 6-7, for 4-terminal resistance measurements, and perform the following steps:

a. Set the A90 to the .1 MA range. The ohmmeter should indicate between 1.00050 and 0.99950 kilohms. If the measured resistance is not within these limits, the .1 MA shunt, R6, is defective and must be replaced.

b. Set the A90 to the 1 MA range. The ohmmeter should indicate between 100.07 and 99.93 ohms. If the measured resistance is not within these limits, the 1 MA shunt, R5, is defective and must be replaced.

6-34. 10 MA, 100 MA, AND 1000 MA RANGE CHECKS. Connect the constant current generator, differential voltmeter, and A90 as shown in Figure 6-8 and perform the following steps:

a. Set the A90 to the 10 MA range.

b. Set the differential voltmeter controls as follows:

RANGE	1 Volt
NULL Sensitivity	100 μV
Readout Dials	0.100000

Table 6-9. RESISTANCE CHECKS

OHMMETER CONNECTIONS	MODEL A90	
	RANGE	APPROXIMATE RESISTANCE (OHMS)
INPUT Terminals	.1 MA	1000
	1 MA	100
	10 MA	10
	100 MA	1
	1000 MA	0.1
	10A	∞
INPUT (10A Terminals)	10A	0.01
OUTPUT Terminals	10A	0.01
	1000 MA	0.1
	100 MA	1
	10 MA	10
	1 MA	100
	.1 MA	1000

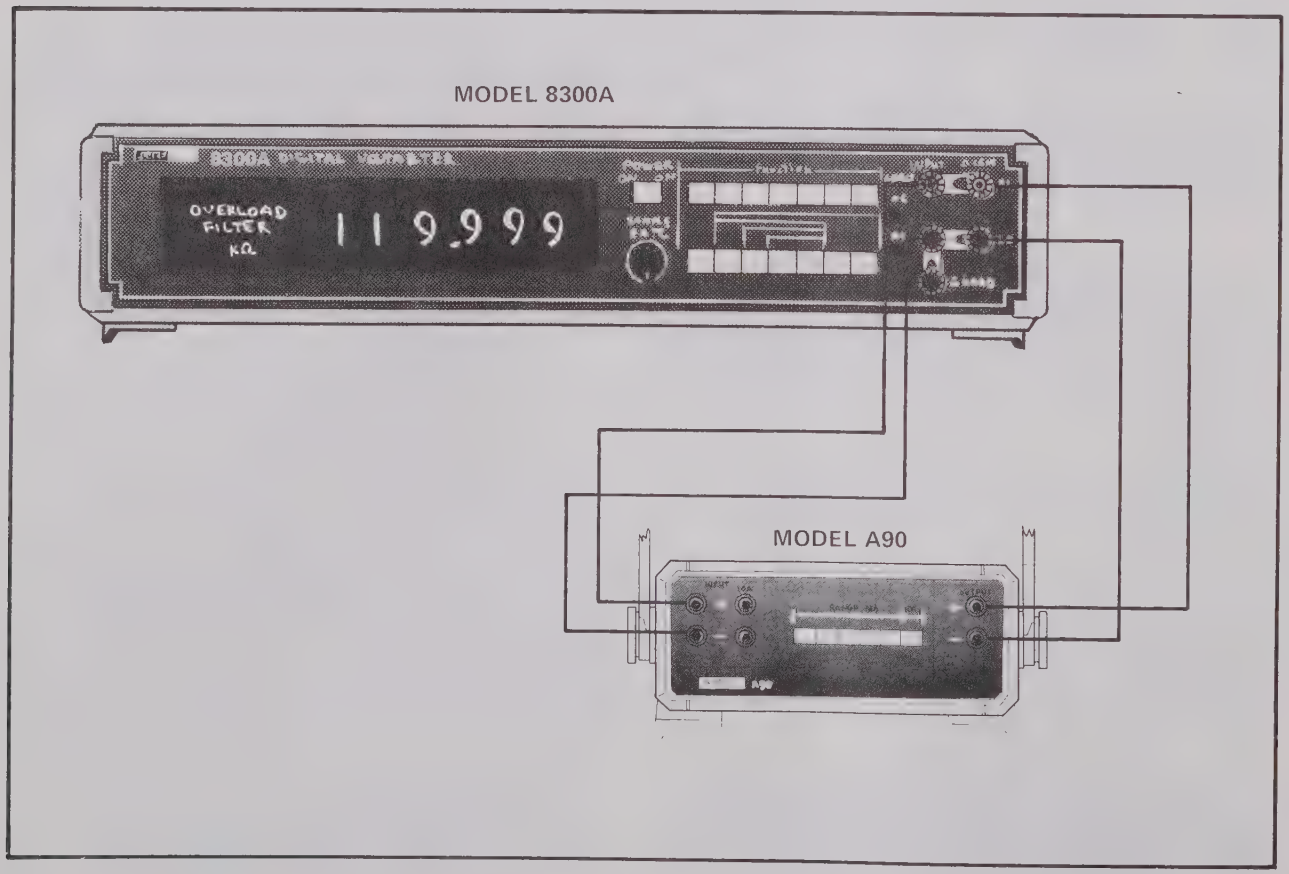


Figure 6-7. EQUIPMENT CONNECTIONS – .1 MA AND 1 MA RANGE CHECKS

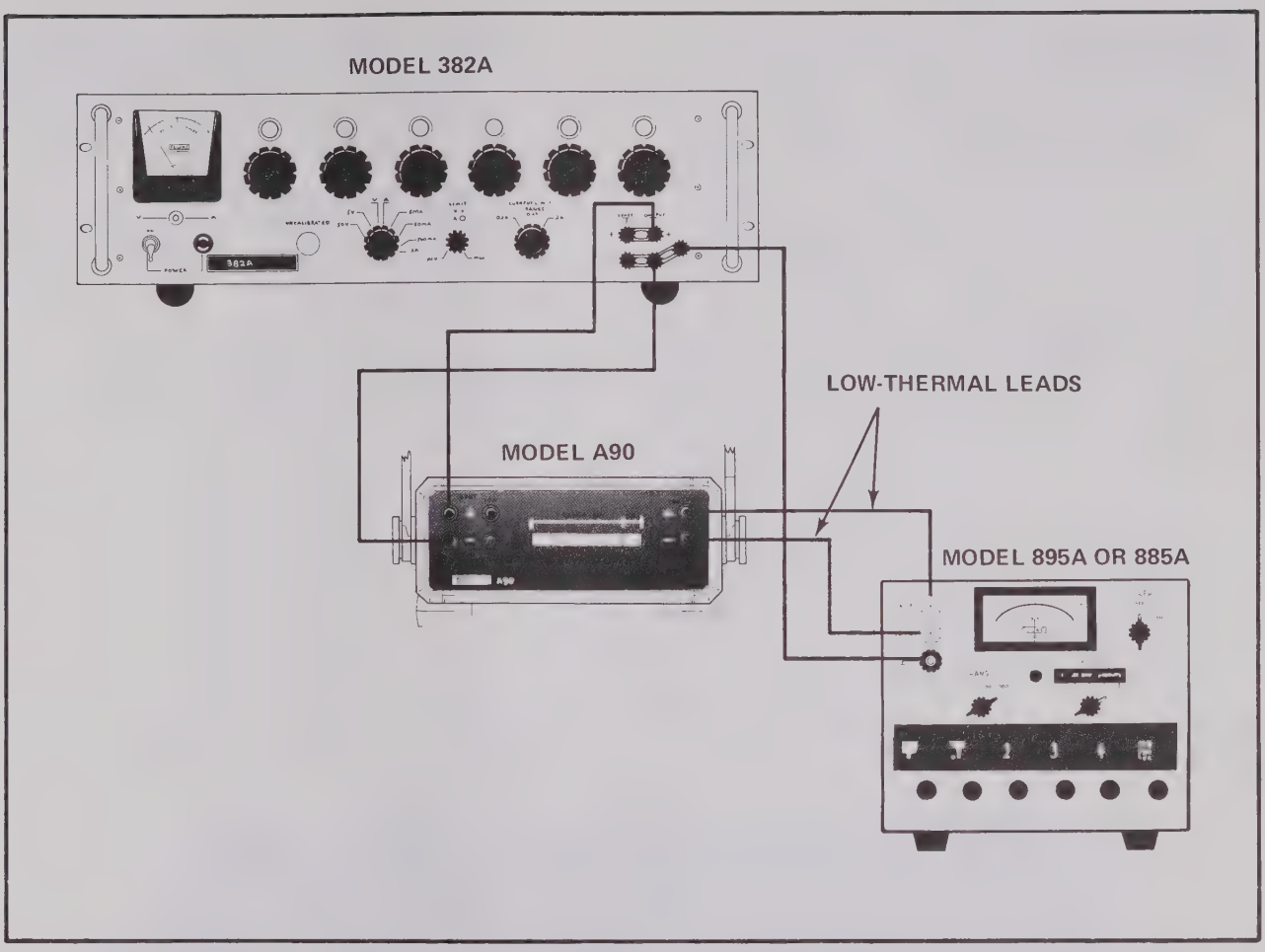


Figure 6-8. EQUIPMENT CONNECTIONS – 10 MA, 100 MA, AND 1000 MA RANGE CHECKS

c. Set the constant current generator for 10.0000 milliamperes output. The differential voltmeter should indicate null within ±80 micorvolts. If the voltmeter does not indicate within these limits, the 10 MA shunt, R4, is defective and must be replaced.

d. Change the A90 range to 100 MA and the constant current generator output to 100 milliamperes. The differential voltmeter should indicate null within ±80 microvolts. If the voltmeter does not indicate within these limits, the 100 MA shunt, R3, is defective and must be replaced.

e. Change the A90 range to 1000 MA and the constant current generator output to 1000 milliamperes. The differential voltmeter should indicate null within ±80 microvolts. If the +80 microvolt limit is not met, the 1000 MA shunt, R2, should be replaced. If the –80 microvolt limit is not met, R2 is low in ohmic value and can be trimmed to its desired value by carefully removing a small amount of material from the edge of the shunt using a whetstone.

6-35. 10 AMPERE RANGE CHECK. Connect equipment as shown in Figure 6-8, leaving the constant current generator temporarily disconnected from the A90, and perform the following steps:

a. Set the differnetial voltmeter controls as follows:

RANGE	1 Volt
NULL Sensitivity	100 μV
Readout Dials	0.00000

The voltmeter should indicate less than ±4 microvolts of thermal offset. If more than ±4 microvolts of offset is observed, check for cold solder joints or possible thermal generators in the test

setup. When thermal offset has been reduced to within ±4 microvolts, proceed to step (b).

b. Connect the constant current generator to the 10 AMP binding posts of the A90 and set the A90 to the 10A range.

c. Set the differential voltmeter controls as follows:

RANGE	1 Volt
NULL Sensitivity	100 μV
Readout Dials	.020000

d. Set the constant current generator output to 2 amperes. The voltmeter should indicate null within ±80 microvolts. If the +80 microvolt limit is not met, the 10 ampere shunt, R1, should be replaced. If the –80 microvolt limit is not met, R1 is low in ohmic value and can be trimmed to its desired value by carefully removing a small amount of material from the edge of the shunt using a whetstone.

6-36. LIST OF REPLACEABLE PARTS

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		CURRENT SHUNT – Figure 6-9	A90					
		Shunt PCB Assembly (See Figure 6-9)	A90-403	89536	A90-403	1		
J1, J2, J5		Binding post, red, +	275552	89536	275552	3		
J3, J4, J6		Binding post, black –	275560	89536	275560	3		
		Cover, bottom	224360	89536	224360	1		
		Cover, top	224352	89536	224352	1		
		Foot	230037	89536	230337	4		
		Handle, carrying	231423	89536	231423	1		
		Panel, front	A90-208	89536	A90-208	1		
		Panel, rear	A90-209	89536	A90-209	1		

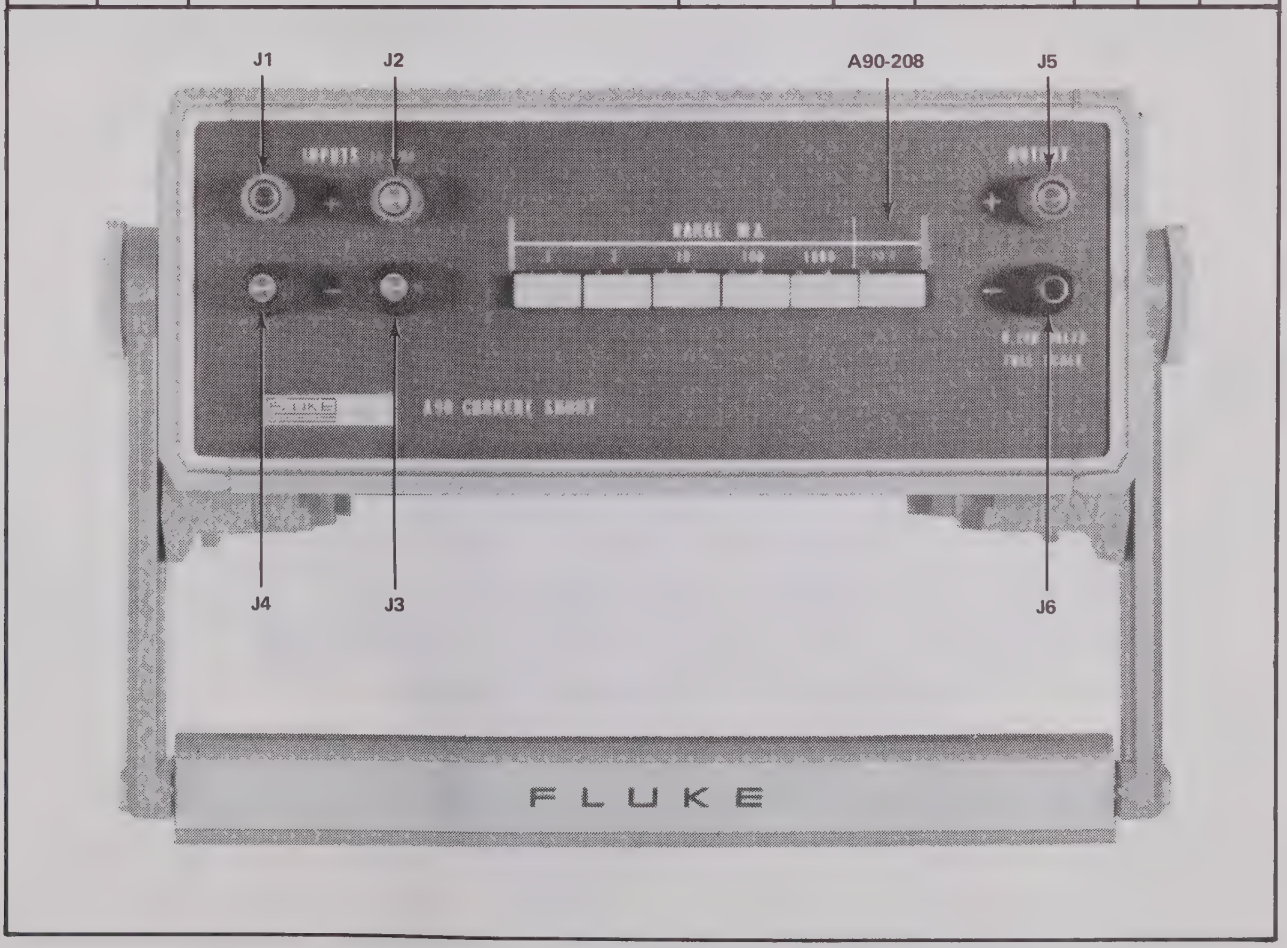


Figure 6-9. MODEL A90 CURRENT SHUNT (Sheet 1 of 2)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		SHUNT PCB ASSEMBLY – Figure 6-9	A90-403	89536	A90-403	REF		
R1		Res, ww, 0.010Ω ±0.2%, 1w	34-4022	89536	34-4022	1		
R2		Res, ww, 0.10Ω ±0.1%, 1w	224121	89536	224121	1		
R3		Res, ww, 1.0Ω ±0.1%, ½w	224089	89536	224089	1		
R4		Res, ww, 10Ω ±0.1%, ½w	224071	89536	224071	1		
R5		Res, ww, 100Ω ±0.03%, ½w	155846	89536	155846	1		
R6		Res, ww, 1 KΩ ±0.04%, ½w	131706	89536	131706	1		
S1 thru S6		Switch assembly,RANGE MA	A90-802	89536	A90-802	1		

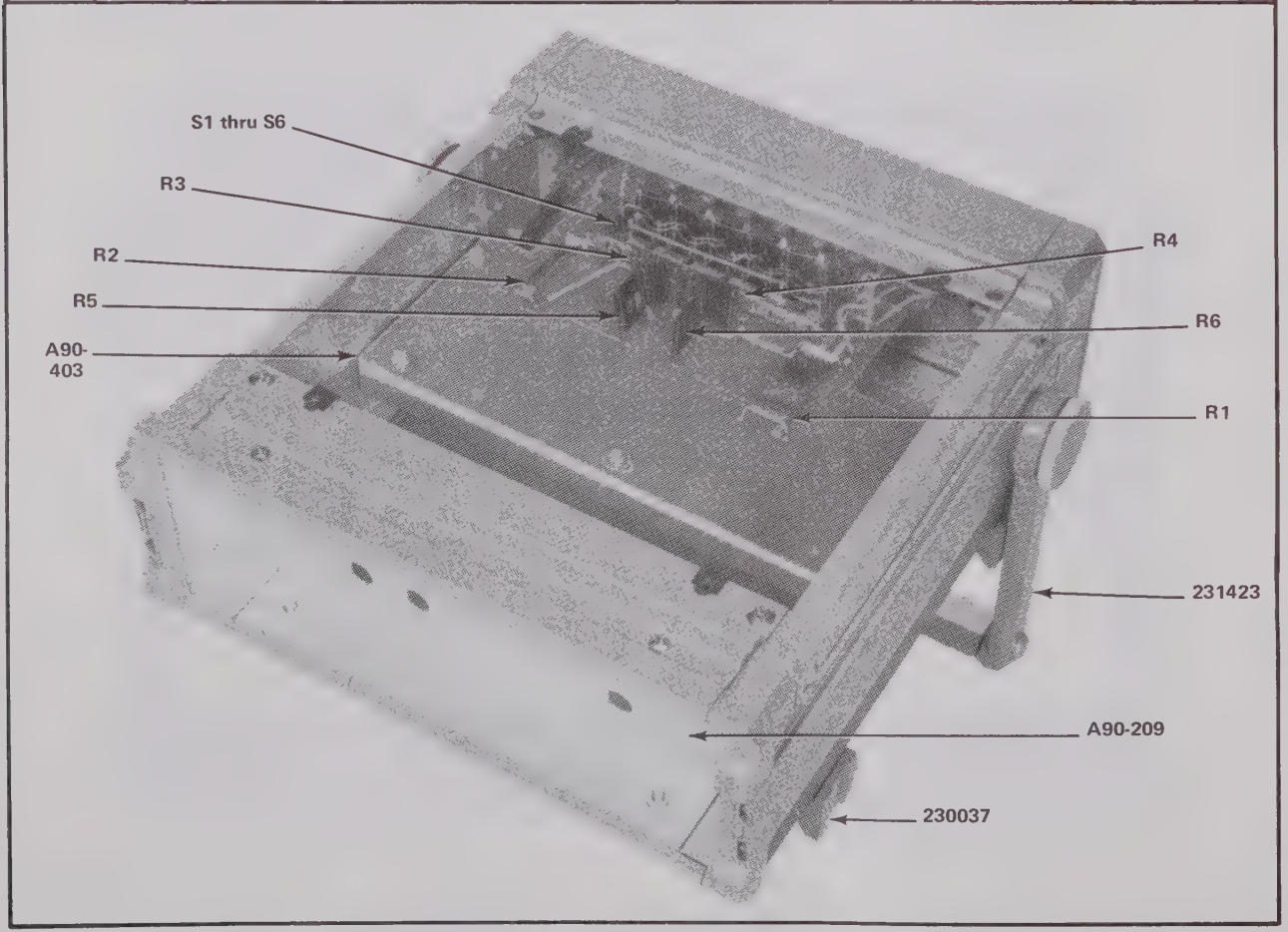
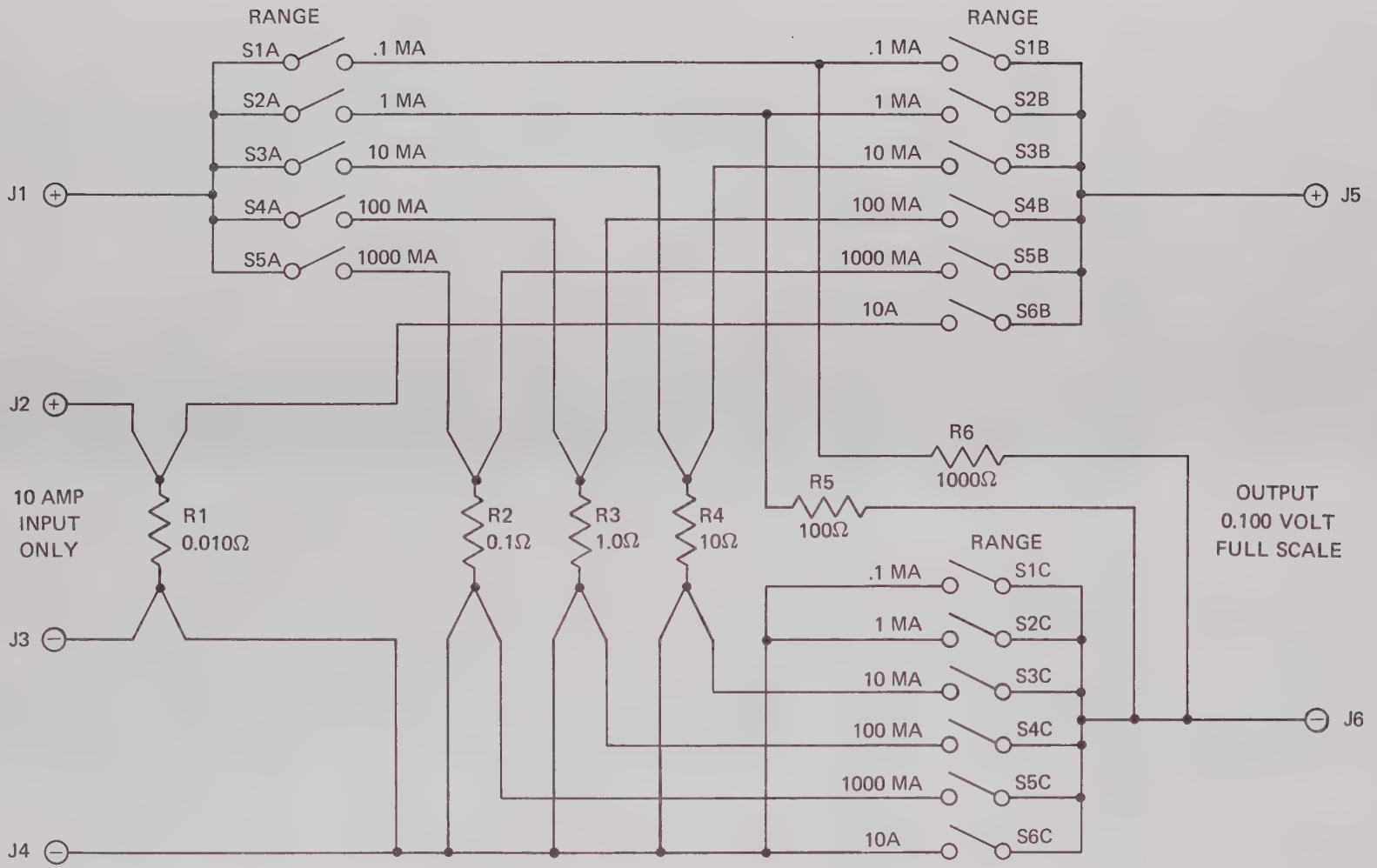


Figure 6-9. MODEL A90 CURRENT SHUNT (Sheet 2 of 2)



FUNCTIONAL SCHEMATIC DIAGRAM

MODEL A90

CURRENT SHUNT

SER. NO. 123 & ON

REV. a

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

Appendix A
Federal Supply Code for Manufacturers

A-1. CODE TO NAME

A-2. The following five digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp. New Bedford, Massachusetts
00686	Film Capacitors Passaic, New Jersey
00779	AMP Inc. Harrisberg, Pennsylvania
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01281	TRW Semiconductors Lawndale, California
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp. Saugerties, New York
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Arco Capacitors, Inc. Torrence, California
03508	General Electric Co. Semiconductor Products Syracuse, New York
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transitron Electronic Corp. Wakefield, Massachusetts
03888	Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey
03911	Clairex Corp. New York, New York
03980	Muirhead Instruments, Inc. Mountainside, New Jersey
04009	Arrow Hart and Hegemen Electronic Company Hartford, Connecticut
04062	Replaced by 72136
04202	Replaced by 81312
04217	Essex Wire Corp. Wire & Cable Div. Anaheim, California
04221	Aemco, Div. of Midtex Inc. Mankato, Minnesota
04222	Aerovox Corp. (H-Q) Myrtle Beach, South Carolina
04645	Replaced by 75376
04713	Motorola Semiconductor Products Inc. Phoenix, Arizona
05082	Replaced by 94154
05236	Jonathan Mfg. Co. Fullerton, California
05277	Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania
05278	Replaced by 43543
05397	Union Carbide Corp. Electronics Div. Cleveland, Ohio
05279	Southwest Machine & Plastic Co. Los Angeles, California
05397	Union Carbide Corp. Electronics Div. New York, New York
05571	Sprague Electric Co. Pacific Div. Los Angeles, California
05574	Viking Industries Chatsworth, California
05704	Alac, Inc. Glendale, California
05820	Wakefield Engineering Ind. Wakefield, Massachusetts
06001	General Electric Company Capacitor Department Irmo, South Carolina
06136	Replaced by 63743
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Corp. Littletown, Colorado
06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div., Components, Inc. Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Varian-Eimac San Carlos, California
07115	Replaced by 14674
07138	Westinghouse Electric Corp., Electronic Tube Division Elmira, New York
07256	Silicon Transistor Corp. Garden City, New York
07263	Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
07344	Bircher Co., Inc. Rochester, New York
07792	Lerma Engineering Corp. Northampton, Massachusetts
07910	Teledyne Corp. (Continental Device) Hawthorne, California
08225	Industro Transistor Corp. Long Island City, New York
08530	Reliance Mica Corp. Brooklyn, New York
08792	Discontinued
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09353	C and K Components Watertown, Massachusetts
09423	Scientific Components, Inc. Santa Barbara, California
09922	Burndy Corp. Norwalk, Connecticut
11236	CTS of Berne Berne, Indiana
11237	Chicago Telephone of Calif., Inc. (CTC) Paso Robles, California
11358	Discontinued
11403	Best Products Co. Chicago, Illinois

11503 Keystone Mfg.
Div. of Avis Industrial Corp.
Warren, Michigan

11726 Qualidyne Corp.
Santa Clara, California

12014 Chicago Rivet & Machine Co.
Bellwood, Illinois

12040 National Semiconductor Corp.
Danburry, Connecticut

12060 Diodes, Inc.
Chatsworth, California

12136 Philadelphia Handle Co.
Camden, New Jersey

12323 Presin Co., Inc.
Shelton, Connecticut

12327 Freeway Washer & Stamping Co.
Cleveland, Ohio

12400 Replaced by 75042

12617 Hamlin Inc
Lake Mills, Wisconsin

12697 Clarostat Mfg. Co.
Dover, New Hampshire

12749 James Electronics
Chicago, Illinois

12856 Micrometals
Sierra Madre, California

12954 Dickson Electronics Corp.
Scottsdale, Arizona

12969 Unitrode Corp.
Watertown, Massachusetts

13103 Thermalloy Co.
Dallas, Texas

13511 Amphenol Corp.
Los Gatos, California

13606 Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839 Replaced by 23732

14099 Semtech Corp.
Newbury Park, California

14193 California Resistor Corp.
Santa Monica, California

14298 American Components, Inc.
Conshohocken, Pennsylvania

14655 Cornell-Dubilier Electronics
Newark, New Jersey

14674 Discontinued, see 16299

14752 Electro Cube Inc.
San Gabriel, California

14869 Replaced by 96853

15636 Elec-Trol Inc.
Northridge, California

15801 Fenwal Electronics Inc.
Framingham, Massachusetts

15818 Amelco Semiconductor
Div. of Teledyne Inc.
Mountain View, California

15849 USECO, Inc.
Mt. Vernon, New York

15898 International Business
Machines (IBM)
Essex Junction, Vermont

15909 Replaced by 17870

16299 Corning Glass
Raleigh, North Carolina

16332 Replaced by 28478

16473 Cambridge Scientific Ind. Inc.
Cambridge, Maryland

16742 Paramount Plastics
Downey, California

16758 Delco Radio
Div. of General Motors
Kokomo, Indiana

17001 ITT Cannon
Santa Ana, California

17069 Circuit Structures Lab.
Upland, California

17856 Siliconix, Inc.
Sunnyvale, California

17870 Daven-Div of Thomas A. Edison
Ind. – McGraw - Edison Co.
Manchester, New Hampshire

18083 Deleted

18178 Vactec Inc.
Maryland Heights, Missouri

18612 Vishay Intertechnology
Inc.
Malvern, Pennsylvania

18736 Voltronics Corp.
Hanover, New Jersey

19429 Discontinued, use 89536

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

20891 Self-Organizing Systems,
Inc.
Dallas, Texas

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23050 Product Comp. Corp.
Mount Vernon, New York

23732 Tracor
Rockville, Maryland

23880 Stanford Applied Engrng.
Santa Clara, California

23936 Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

24759 Lenox-Fugle Electronics
Plainfield, New Jersey

25403 Amperex Electronic Corp.
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

27014 National
Semiconductor
Corp.
Santa Clara, California

27264 Molex Products
Downers Grove, Illinois

28425 Bohannon Industries
Fort Worth, Texas

28478 Deltrol Controls.
Corp.
Milwaukee, Wisconsin

28480 Hewlett Packard
Co.
Palo Alto, California

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

29083 Monsanto, Co., Inc.
Santa Clara, California

30323 Illinois Tool
Works, Inc.
Chicago, Illinois

32539 Mura Corp.
Great Neck, New York

32767 Griffith Plastic
Products Co.
Burlingame, California

32879 Advanced Mechanical
Components
Northridge, California

32897 Erie Technological
Products, Incorporated
Frequency Control Div.
Carlisle, Pennsylvania

33173 General Electric
Co., Tube Dept.
Owensboro, Kentucky

34333 Silicon General
Westminster, California

34335 Advanced Micro
Devices.
Sunnyvale, California

37942 Mallory, P. R. & Co., Inc.
Indianapolis, Indiana

42498 National Company
Melrose, Massachusetts

43543 Nytronics Inc.
Transformer Co. Div.
Alpha, New Jersey

44655 Ohmite Mfg. Co.
Skokie, Illinois

49671 Radio Corp. of America
New York, New York

49956 Raytheon Company
Lexington, Maine

53021 Sanamo Electric Co.
Springfield, Illinois

55026 Simpson Electric Company
Chicago, Illinois

56289 Sprague Electric Co.
North Adams, Massachusetts

58474 Superior Electric Co.
Bristol, Connecticut

60399 Torrington Mfg. Co.
Torrington, Connecticut

62460 Deleted

63743 Ward Leonard Electric Co.
Mount Vernon, New York

64834 West Mfg. Co.
San Francisco, California

65092 Weston Instruments Inc.
Newark, New Jersey

66150 Winslow Tele-Tronics Inc.
Asbury Park, New Jersey

70563 Amperite Company
Union City, New Jersey

70903 Belden Mfg. Co.
Chicago, Illinois

71002 Birnbach Radio Co., Inc.
New York, New York

71236 "TLMLNCO"
Willimantic, Connecticut

71400 Bussmann Mfg.
Div. of McGraw - Edison Co.
Saint Louis, Missouri

71450 CTS Corp.
Elkhart, Indiana

71468 ITT Cannon Electric Inc.
Los Angeles, California

71482 Clare, C. P. & Co.
Chicago, Illinois

71590 Centralab
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707 Coto Coil Co., Inc.
Providence, Rhode Island

71744 Chicago Miniature Lamp Works
Chicago, Illinois

71785 Cinch Mfg. Co. & Howard
B. Jones Div.
Chicago, Illinois

72005 Driver, Wilber B., Co.
Newark, New Jersey

72092 Replaced by 06980

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72259 Nytronics Inc.
Berkeley Heights, New Jersey

72354 Deleted

72619 Dialight Corp.
Brooklyn, New York

72653 G. C. Electronics
Rockford, Illinois

72665 Replaced by 90303

72794 Dzus Fastener Co., Inc.
West Islip, New York

72928 Gudeman Co. (Gulton
Industries)
Chicago, Illinois

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445 Amperex Electronic Corp.
Hicksville, New York

73559 Carling Electric Inc.
Hartford, Connecticut

73586 Circle F Industries
Trenton, New Jersey

73734 Federal Screw Products, Inc.
Chicago, Illinois

73743 Fischer Special Mfg. Co.
Cincinnati, Ohio

73899 JFD Electronics Co.
Brooklyn, New York

73949 Guardian Electric Mfg. Co
Chicago, Illinois

74199 Quam Nichols Co.
Chicago, Illinois

74217 Radio Switch Corp.
Marlboro, New Jersey

74276 Signalite Inc.
Neptune, New Jersey

74306 Piezo Crystal Co.
Carlisle, Pennsylvania

74542 Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970 Johnson, E. F., Co.
Waseca, Minnesota

75042 IRC Inc. (Div. of TRW)
Philadelphia, Pennsylvania

75376 Kurz-Kasch, Inc.
Dayton, Ohio

75382 Kulka Electric Corp.
Mount Vernon, New York

75915 Littlefuse Inc.
Des Plaines, Illinois

76854 Oak Mfg. Co.
Crystal Lake, Illinois

77342 Potter & Brumfield
Div. of Amer. Machine & Foundry
Princeton, Indiana

77969 Rubbercraft Corp. of Calif. LTD.
Torrance, California

78189 Shakeproof
Div. of Illinois Tool Works
Elgin, Illinois

78277 Sigma Instruments, Inc.
South Braintree, Massachusetts

78488 Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553 Tinnerman Products
Cleveland, Ohio

79136 Waldes Kohinoor Inc.
Long Island City, New York

79497 Western Rubber Company
Goshen, Indiana

79963 Zierick Mfg. Corp.
New Rochelle, New York

80031 Mepco
Div. of Sessions Clock Co.
Morristown, New Jersey

80145 API Instruments Co.
Chesterland, Ohio

80183 Sprague Products
North Adams, Massachusetts

80294 Bourns Inc.
Riverside, California

80583 Hammarlund Co., Inc.
Mars Hill, North Carolina

80640 Stevens, Arnold Inc.
Boston, Massachusetts

81073 Grayhill Inc.
La Grange, Illinois

81590 Korry Mfg. Co.
Seattle, Washington

81312 Winchester Electronics
Div. of Litton Industries
Oakville, Connecticut

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp.
Los Angeles, California

81741 Chicago Lock Corp.
Chicago, Illinois

82305 Palmer Electronics
South Gate, California 90280

82389 Switchcraft Inc.
Chicago, Illinois

82415 Price Electric Corp.
Frederick, Maryland

82872 Roanwell Corp.
New York, New York

82877 Rotron Mfg. Co., Inc.
Woodstock, New York

82879 ITT Wire & Cable Div.
Pawtucket, Rhode Island

83003 Varo Inc.
Garland, Texas

83298 Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330 Smith, Herman H., Inc.
Brooklyn, New York

83478 Rubbercraft Corp. of America
New Haven, Connecticut

83594 Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740 Union Carbide Corp.
Consumer Products Div.
New York, New York

84171 Arco Electronics, Inc.
Great Neck, New York

84411 TRW
Ogallala, Nebraska

86577 Precision Metal Products
Stoneham, Massachusetts

86684 Radio Corp. of America
Electronic Components & Devices
Harrison, New Jersey

86689 Deleted

87034 Marco-Oak Inc.
Anaheim, California

88245 Litton Products Inc.
Van Nuys, California

88419 Use 14655

88690 Replaced by 04217

89536 Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730 Replaced by 08806

90201 Mallory Capacitor Co.
Indianapolis, Indiana

90215 Best Stamp & Mfg. Co
Kansas City, Missouri

90211 Square D Co.
Chicago, Illinois

90303 Mallory Battery Co.
Tarrytown, New York

91293 Johanson Mfg. Co.
Boonton, New Jersey

91407 Replaced by 58474

91502 Associated Machine
Santa Clara, California

91506 Augat
Attleboro, Mass.

91637 Dale Electronics Inc.
Columbus, Nebraska

91662 Elco Corp.
Willow Grove, Pennsylvania

91737 Gremar Mfg Co., Inc. (ITT)
Woburn, Massachusetts

91802 Industrial Devices, Inc.
Edgewater, New Jersey

91836 King's Electronics
Tuckahoe, New York

91929 Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934 Miller Electric Co., Inc.
Pawtucket, Rhode Island

93332 Sylvania Electric Products
Semiconductor Products Div
Woburn, Massachusetts

94145 Replaced by 49956

94154 Tung-Sol
Div. of Wagner Electric Corp.
Newark, New Jersey

95146 Alco Electronics Products Inc.
Lawrence, Massachusetts

95263 Leecraft Mfg. Co.
Long Island City, New York

95264 Replaced by 98278

95275 Vitramon Inc.
Bridgeport, Connecticut

95303 Radio Corp. of America
Solid State & Receiving Tube Div.
Cincinnati, Ohio

95354 Methode Mfg. Corp.
Rolling Meadows, Illinois

95712 Dage Electric Co., Inc.
Franklin, Indiana

95987 Weckesser Co, Inc.
Chicago, Illinois

96733 San Fernando Electric Mfg. Co.
San Fernando, California

96853 Rustrak Instrument Co.
Manchester, New Hampshire

96881 Thomson Industries, Inc.
Manhasset, New York

97540 Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Los Angeles, California

97913 Industrial Electronic Hdware Corp.
New York, New York

97945 White, S. S. Co.
Plastics Div.
New York, New York

97966 Replaced by 11358

98094 Replaced by 49956

98159 Rubber-Teck, Inc.
Gardena, California

98278 Microdot Inc.
Pasadena, California

98291 Sealectro Corp.
Conhex Div.
Mamaroneck, New York

98388 Accurate Rubber & Plastics
Culver City, California

98743 Replaced by 12749

98925 Deleted

99120 Plastic Capacitors, Inc.
Chicago, Illinois

99217 Southern Electronics Corp.
Burbank, California

99392 STM
Oakland, California

99515 Marshall Industries
Capacitor Div.
Monrovia, California

99779 Barnes Corp.
Lansdowne, Pennsylvania

Toyo Electronics
(R-Ohm Corp.)
Irvine, California 92664

National Connector
Minneapolis, Minn. 55436

Appendix B
List of Abbreviations

alternating current	ac
ampere	A
assembly	assy
binary coded decimal	bcd
bel	B
capacitor	cap
centimeter	cm
ceramic	cer
clockwise	cw
common-mode rejection ratio	cmrr
composition	comp
counterclockwise	ccw
decibel	dB
degree Celsius	°C
degree Fahrenheit	°F
digital voltmeter	dvm
direct current	dc
electrolytic	elect
external	ext
farad	F
field effect transistor	FET
germanium	Ge
giga (10^9)	G
gigahertz	GHz
ground	gnd
guard	gd
henry	H
hertz	Hz
high frequency	hg
hour	h
inch	in
integrated circuit	IC
intermediate frequency	if
internal	intl
kilo (10^3)	k
kilohertz	kHz
kilohm	kΩ
kilovolt	kV
low frequency	lf
maximum	max
mega (10^6)	M
megahertz	MHz
megohm	MΩ
meter	m
micro (10^{-6})	μ
microsecond	μs
milli (10^{-3})	m
milliamperes	mA
millimeter	mm
millisecond	ms
millivolt	mV
minimum	min
nano (10^{-9})	n
nanosecond	ns
negative	neg
ohm	Ω
oscilloscope	scope
parts per million	ppm
peak-to-peak	p-p
pico (10^{-12})	p
picofarad	pF
plus or minus	±
positive	pos
plastic	plstc
printed circuit board	pcb
radio frequency	rf
root mean square	rms
second (time)	s
serial number	SN
silicon	Si
tantalum	Ta
temperature coefficient	TC
tera (10^{12})	T
transformer	xfmr
transistor	xstr
ultra high frequency	uhf
variable	var
very high frequency	vhf
very low frequency	vlf
volt	V
voltage controlled oscillator	vco
watt	W
wirewound	ww

Appendix C

Sales Representatives

ALABAMA

HUNTSVILLE
BCS Associates, Inc.
3322 S. Memorial Parkway
P.O. Box 1273
Tel. (205) 881-6220
Zip 35801

ALASKA

SEATTLE
Showalter-Judd, Inc.
5616 4th Ave. South
Tel. (206) 762-2310
Zip 98108

ARIZONA

PHOENIX
Barnhill Associates
7329 E. Stetson Dr.
Tel. (602) 947-7841
Scottsdale, AZ 85251

CALIFORNIA

LOS ANGELES
Instrument Specialists, Inc.
1109 S. Central Ave.
Glendale, California 91204
Tel. (213) 245-9404

SANTA CLARA
Instrument Specialists, Inc.
2359 De La Cruz Blvd.
Tel. (408) 244-1505
Zip 95050

SAN DIEGO
Instrument Specialists, Inc.
4805 Mercury St., Ste. 1
Tel. (714) 565-2555
Zip 92111

COLORADO

DENVER
Barnhill Associates
1170 S. Sheridan Blvd.
Tel. (303) 934-5505
Zip 80226

CONNECTICUT

HARTFORD
Instrument Representatives, Inc.
P.O. Box 165
Glastonbury, Connecticut 06033
Tel. (203) 633-0777

FLORIDA

ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
Tel. (305) 896-4881
Zip 32803

HAWAII

HONOLULU
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

ILLINOIS

CHICAGO
Cozzens & Cudahy, Inc.
1301 N. Rand Rd.
Des Plaines, IL 60016
Tel. (312) 298-3600

INDIANA

INDIANAPOLIS
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46224

MARYLAND

BALTIMORE
Electronic Marketing Assoc. Inc.
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300, 744-7700

MASSACHUSETTS

BOSTON
Instrument Representatives, Inc.
109 Massachusetts Ave.
Lexington, MA 02173
Tel. (617) 861-8620

MICHIGAN

DETROIT
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

MINNESOTA

MINNEAPOLIS
Cozzens & Cudahy, Inc.
10800 Lyndale Ave. S.
Tel. (612) 884-4336
Zip 55420

MISSOURI

ST. LOUIS
Cozzens & Cudahy, Inc.
P.O. Box 10013
Lambert Field - Zip 63145
Tel. (314) 423-1234

NEW JERSEY

NEWARK
SBM Representatives
1519 Stuyvesant Avenue
Union, New Jersey 07083
Tel. (201) 687-8737

NEW MEXICO

ALBUQUERQUE
Barnhill Associates
1410 — D Wyoming N.E.
Tel. (505) 299-7658
Zip 87112

NEW YORK

NEW YORK
SBM Representatives
28 Hobby Street
Pleasantville, N.Y. 10570
Tel. (914) 769-1811

ROCHESTER
SBM Representatives
4515 Culver Rd.
Tel. (716) 226-1400
Zip 14622

NORTH CAROLINA

GREENSBORO
P.O. Box 9619
1310 Beahan Pl.
Tel. (919) 273-1918
Zip 27408

OHIO

CLEVELAND
WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

DAYTON
WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45459

PENNSYLVANIA

PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd., Ste. 100
King of Prussia, Pennsylvania
Tel. (215) 248-5050
Zip 19406

PITTSBURGH
WKM Associates, Inc.
90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

TEXAS

DALLAS
Barnhill Associates
Suite 220
312 N. Central Express Wy.
Richardson, Texas 75080
Tel. (214) 231-2573

HOUSTON
Barnhill Associates
Suite 332
3810 Westheimer
Tel. (713) 621-0040
Zip 77027

WASHINGTON

SEATTLE
Showalter-Judd, Inc.
5616 4th Ave. South
Tel. (206) 762-2310
Zip 98108

CANADA

BRITISH COLUMBIA

VANCOUVER
Allan Crawford Associates, Ltd.
1820 Pandora St.
Tel. (604) 253-7136

ALBERTA

CALGARY
Allan Crawford Associates, Ltd.
640 - 11th Ave. S.W.
Tel. (403) 261-0780

ONTARIO

MALTON
Allan Crawford Associates, Ltd.
6427 Northam Drive
Tel. (416) 678-1500

OTTAWA, 3
Allan Crawford Associates, Ltd.
376 Churchill Ave., Suite 106
Tel. (613) 829-9651

QUEBEC

LONGUEUIL
Allan Crawford Associates, Ltd.
157 (rue) St. Charles Street W.
Tel. (514) 670-1212

INTERNATIONAL REPRESENTATIVES

ARGENTINA
Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina

AUSTRALIA
Elmeasco Instruments
P.O. Box 334
Brookvale, N.S.W. Australia 2100

AUSTRIA
Kontron GMBH & Co., Kg.
Lederergasse 16
1080 Vienna, Austria

BELGIUM
C.N. Rood S.A.
37 Place de Jamblinne de Meux
1040 Brussels, Belgium

BRAZIL
Ambriex S.A.
Rue Ceara, 104 - 2.º e 3.º Andares
ZC - 29
Rio de Janeiro GB, Brazil

Ambriex S.A.
Rua Tupi, 535
01233 Sao Paulo SP, Brazil

CARIBBEAN
West Indies Sales Co.
606 Calle Aboy
San Juan, Puerto Rico 00907

CHILE
Coasin Chile Ltd.
Casilla 14588 - Correo 15
Santiago, Chile

CHINA, Peoples Republic Of
May Lee Industries, Inc.
475 Park Avenue South
New York, N.Y. 10016

COLOMBIA
Marones Ltda.
Apartado Aereo 90687
Bogota 8, Colombia

DENMARK
Tage Olsen A/S
1, Rønnegade
Copenhagen Ø, Denmark

ECUADOR
Proteco Coasin Cia., Ltda.
Apartado 228A
Quito, Ecuador

FINLAND
Oy Findip AB
P.O. Box 25
00521 Helsinki 52, Finland

FRANCE
M.B. Electroniques S.A.
29, Rue Emile Duclaux
92, Suresnes
France

GERMANY
Fey Elektronische Messgerate
8 Muenchen 19
Horemansstrasse 28
West Germany

GREECE
Marios Dalleggio Representations
2 Alopekis Street
Athens 19 Greece

HONG KONG & MACAU
Gilman & Co., Ltd.
P.O. Box 56
Hong Kong

INDIA
Hinditron Services Pvt. Ltd.
69/A Nepean Sea Road
Bombay-6 India

IRAN
Berkeh Company Ltd.
20 Salm Road, Roosevelt Ave.
Tehran, Iran

ISRAEL
R.D.T. Electronics Engineering Ltd.
19 Prof. Shor Street
Tel-Aviv, Israel

ITALY
Sistrel S.P.A.
Via Giorgio da Sebenico 11-13
Rome, Italy

JAPAN
Toyo Trading Co. Ltd.
P.O. Box 5014
Tokyo International
Tokyo 100-31, Japan

Suzuki Bldg.
2-38 Junkeicho-dori
Minami-ku, Osaka

KOREA
Asia Science & Co.
Internaltion P.O. Box 1250
Seoul, Korea

MALAYSIA
O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu
East Malaysia

P.O. Box 91
Petaling Jaya, Selangor
West Malaysia

MEXICO
Mexitek, S.A.
Eugenia 408
Departments 1 y 5
Mexico 12, D.F.
Mexico

THE NETHERLANDS
C.N. Rood B.V.
13 - Cort van der Lindenstraat
Rijswijk (Z.H.) 2100
Netherlands

Fluke (Nederland) B.V.
Ledeboerstraat 27
Industrieterrein Noord
Tilburg, Netherlands

NEW ZEALAND
David J. Reid (N.Z.) Ltd.
C.P.O Box 2630
Auckland 1, New Zealand

NIGERIA
Deemtee Electrotechnics Ltd.
P.O. Box 3073
Lagos, Nigeria

NORWAY
Morgenstierne & Co. A/S
P.O. Box 6688 Rodeløkka
Oslo 5, Norway

PAKISTAN
Pak International Operations
505 Muhammadi House-McLeod Rd.
P.O. Box 5323
Karachi, Pakistan

PERU
Importaciones y Representaciones Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru

PORTUGAL
Equipamentos De Laboratorio, Lda.
P.O. Box 1100
Lisbon, Portugal

SINGAPORE
O'Connor's (Pte) Ltd.
98 Pasir Panjang Road
Singapore 5, Singapore

SOUTH AFRICA
K. Baker Associates (Pty) Ltd.
P.O. Box 1257
Johannesburg
Republic of South Africa

P.O. Box 3641
Cape Town

SPAIN
Atalo Ingenieros S.A.
Enrique-Larretta 12
Madrid 16, Spain

SWEDEN
Teleinstrument AB
P.O. Box 490
S-16204 Vallingby
Sweden

SWITZERLAND
Kontron Electronic A.G.
Bernerstrasse Sud 169
8048 Zurich
Switzerland

TAIWAN-REPUBLIC OF CHINA
Heighten Trading Company, Ltd.
P.O. Box 1408
Taipei, Taiwan 104

THAILAND
G. Simon Radio Ltd.
30 Patpong Avenue
Suriwong
Bangkok, Thailand

THE UNITED KINGDOM
Fluke International Corp.
Garnett Close
Watford, WD2 4TT
England

URUGUAY
Coasin Uruguay S.A.
Cerrito 617 - 4º Pisco
Montevideo, Uruguay

U.S.S.R.
Codevintec Pacific Inc.
6263 Variel
Woodland Hills, Calif. 91364

VENEZUELA
Coasin C.A.
Apdo. Postal 50939
Sabana Grande No.1
Caracas 105
Venezuela

In Europe, contact FLUKE NEDERLAND, B.V., POST OFFICE BOX 5053, INDUSTRIETERREIN NOORD, TILBURG, THE NETHERLANDS

FLUKE REGIONAL SERVICE CENTER; THE NETHERLANDS

FLUKE (NEDERLAND) B.V.
P.O. BOX 5053
TILBURG, THE NETHERLANDS

FLUKE REGIONAL SERVICE CENTER, UNITED KINGDOM

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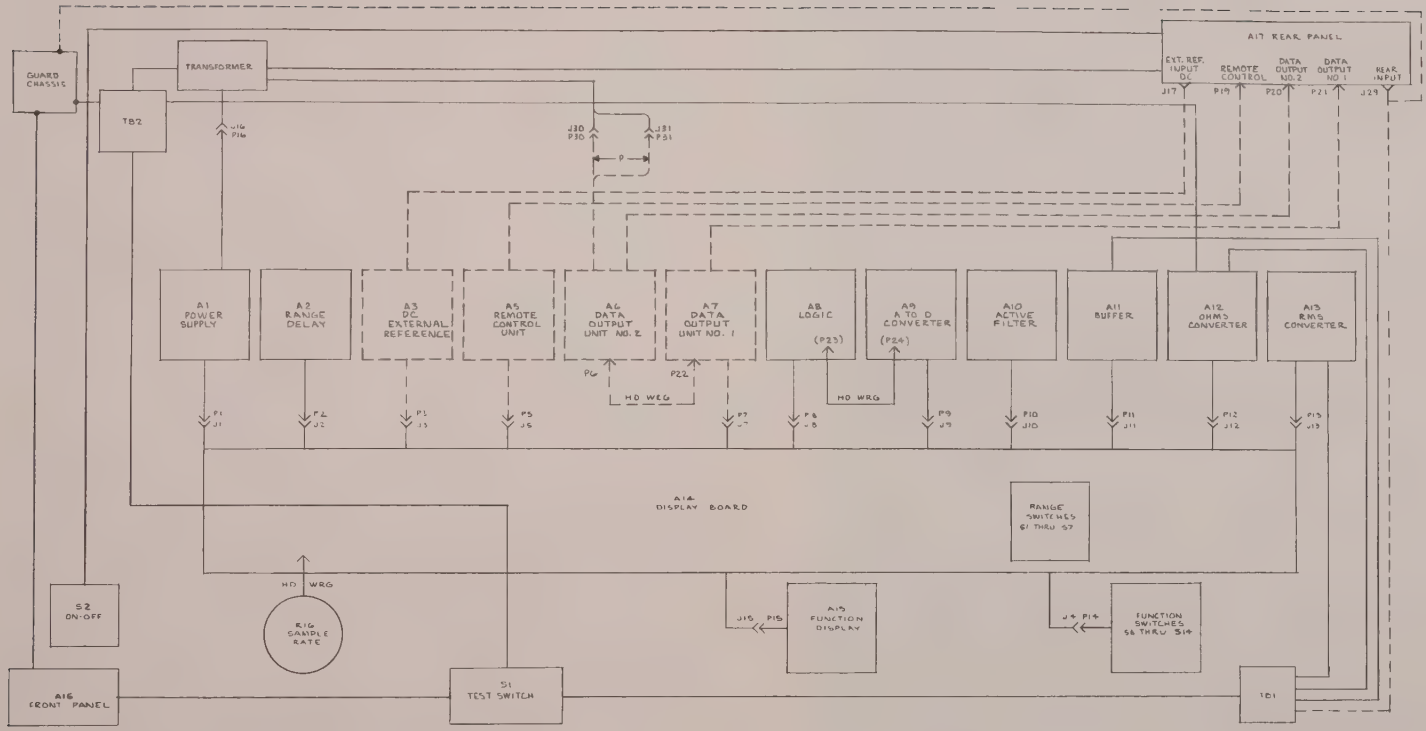


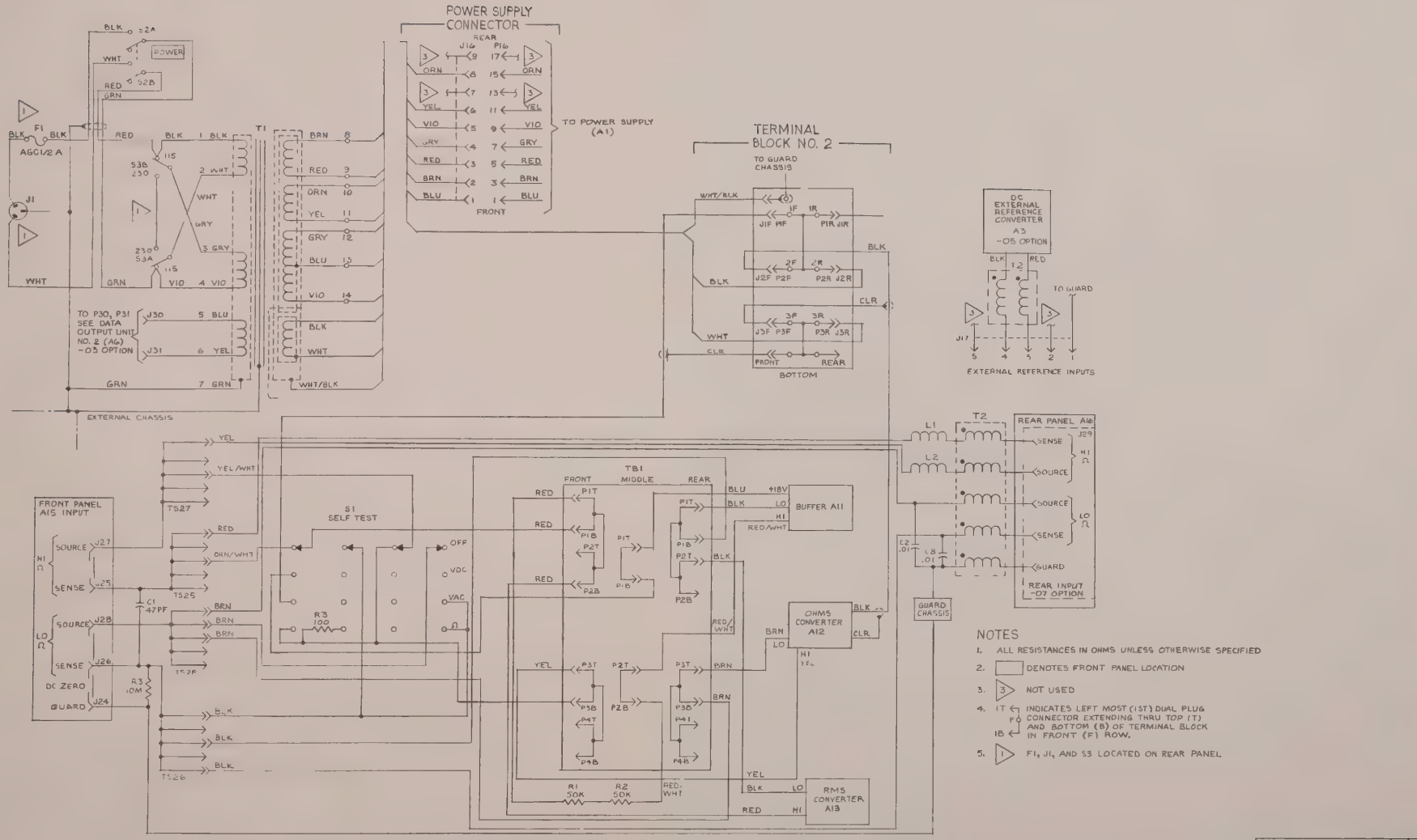
NOTES:

1. HD WRG — HARD WIRING NOT TO BE DISCONNECTED
2. ------ CONNECTIONS FOR OPTIONS

CHANGE DESCRIPTION	DR	CHK	APPR

INTERCONNECT DIAGRAM

PART NO	SIZE	DRAWING NO.
	D	8375A-1100
SCALE	SHT	OF REV
	DIST	



NOTES

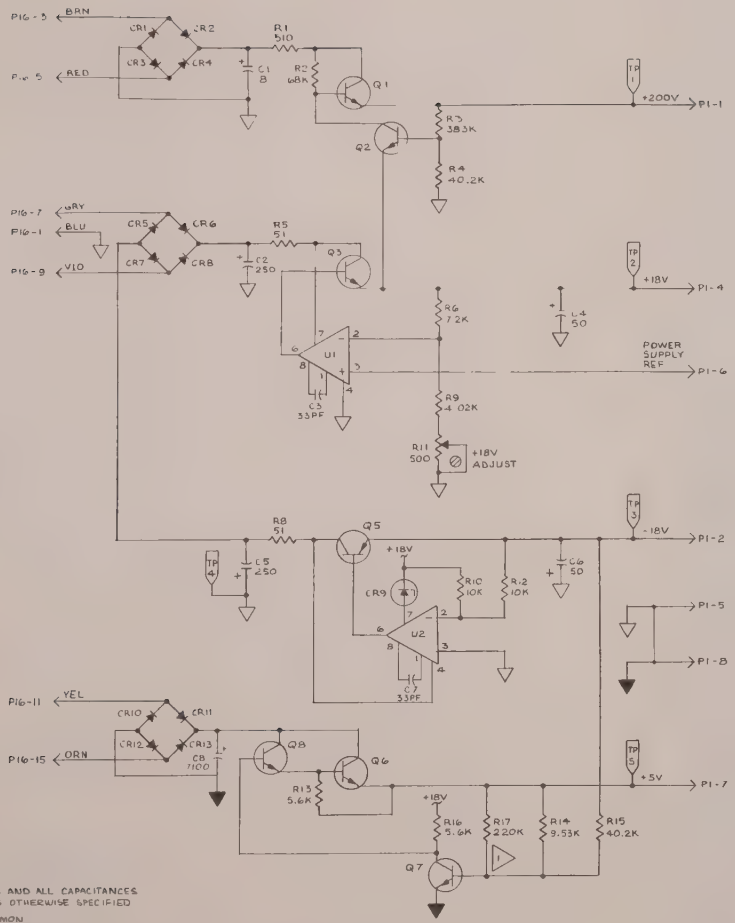
1. ALL RESISTANCES IN OHMS UNLESS OTHERWISE SPECIFIED
2. ▭ DENOTES FRONT PANEL LOCATION
3. ③ NOT USED
4. 1T ← INDICATES LEFT MOST (1ST) DUAL PLUG
   P ○ CONNECTOR EXTENDING THRU TOP (T)
   1B ← AND BOTTOM (B) OF TERMINAL BLOCK IN FRONT (F) ROW.
5. ① F1, J1, AND S3 LOCATED ON REAR PANEL

CHANGE DESCRIPTION	DR	CHK	APPR

WIRING DIAGRAM

PART NO	SIZE	DRAWING NO.
	D	8375A-1000

SCALE	SHT	OF	REV



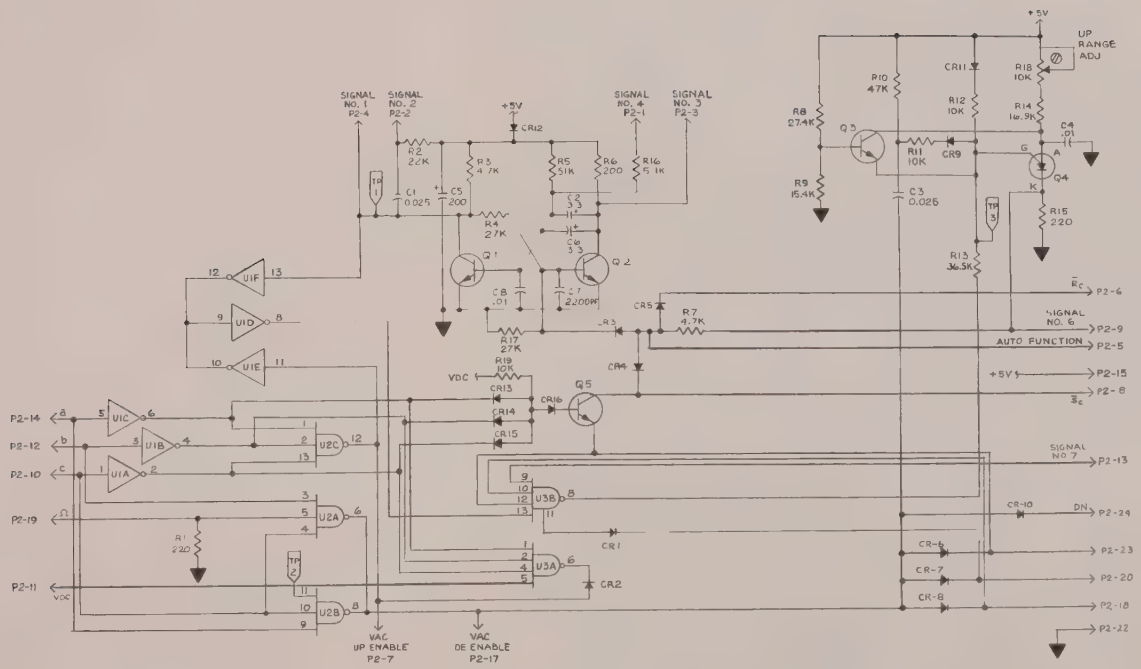
NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. ▽ DENOTES SIGNAL COMMON
3. ▼ DENOTES LOGIC COMMON
4. ⊘ DENOTES INTERNAL ADJUSTMENT
5. (1) R17 MAY BE OMITTED DURING ADJUSTMENT OF +5V SUPPLY

CHANGE DESCRIPTION	DR	CHK	APPR

A1
POWER SUPPLY

PART NO.	SIZE	DRAWING NO.
	D	8375A-1001
SCALE	SHT	OF	REV
			DIST



NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. ▼ DENOTES LOGIC COMMON
3. ⊘ DENOTES INTERNAL ADJUSTMENT

IC	PIN CONNECTIONS	
	+5V	COMMON
U1	14	7
U2	14	7
U3	14	7

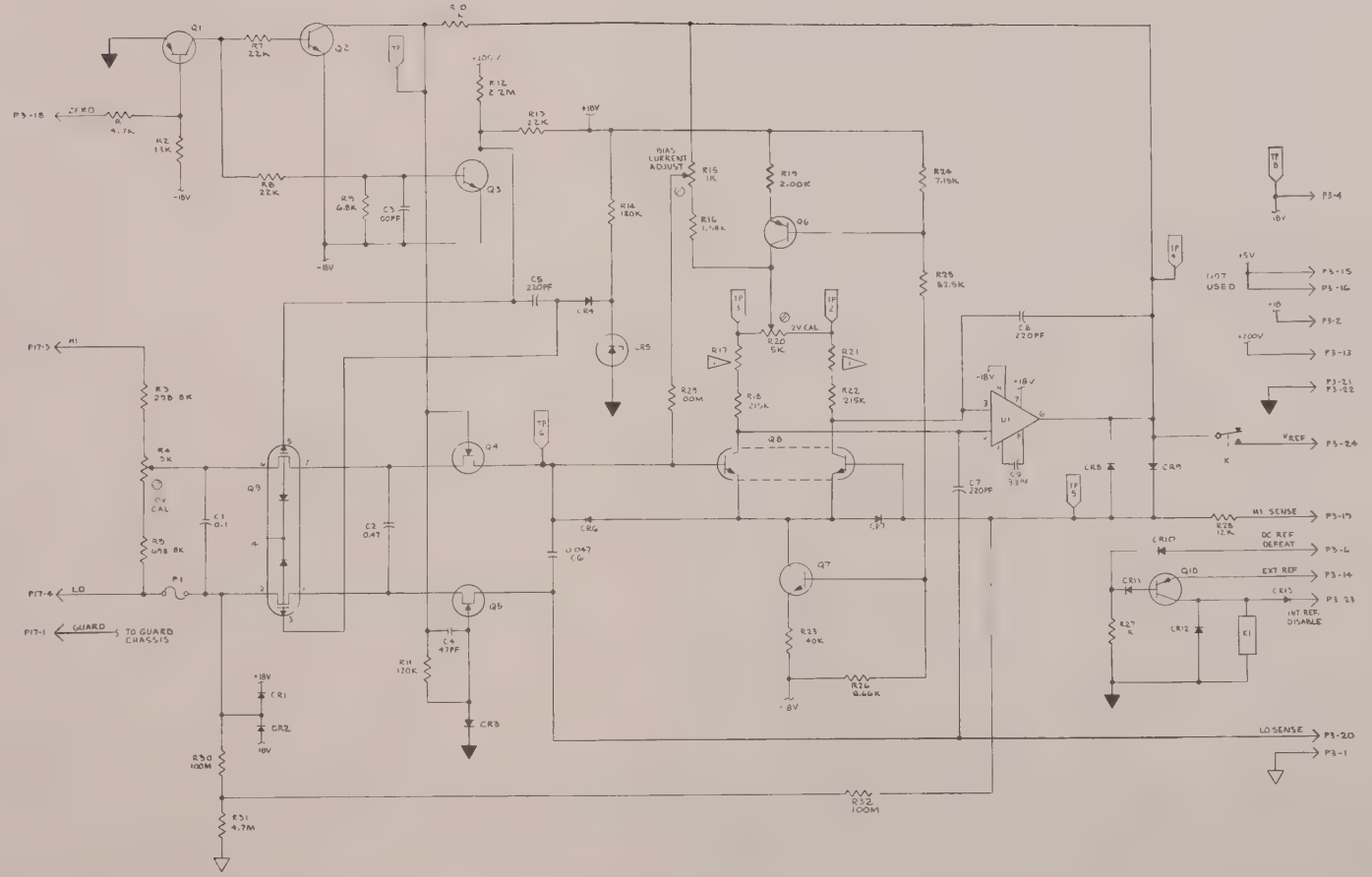
CHANGE DESCRIPTION	DR	CHK	APPR

A2
RANGE DELAY

PART NO	SIZE	DRAWING NO
	D	8375A-1006

SCALE	SHT	OF	REV

DIST



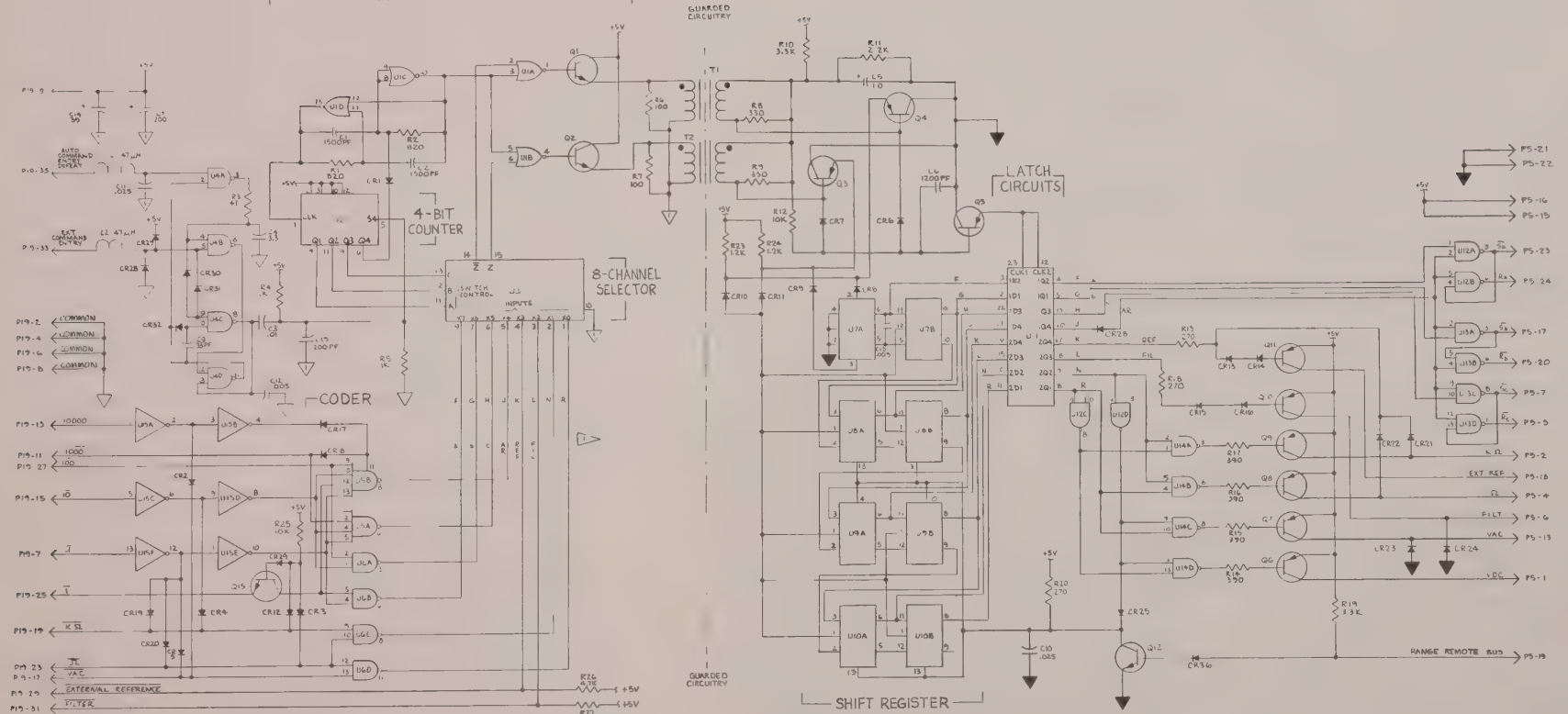
NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. ▽ DENOTES SIGNAL COMMON
3. ▼ DENOTES LOGIC COMMON
4. ⊘ DENOTES INTERNAL ADJUSTMENT
5. ▷ DENOTES FACTORY SELECTED PART

CHANGE DESCRIPTION	DR	CHK	APPR

A3
DC EXTERNAL REFERENCE

PART NO.	SIZE	DRAWING NO.
	D	8375A-1009
SCALE	SHT	OF REV
	SHT	

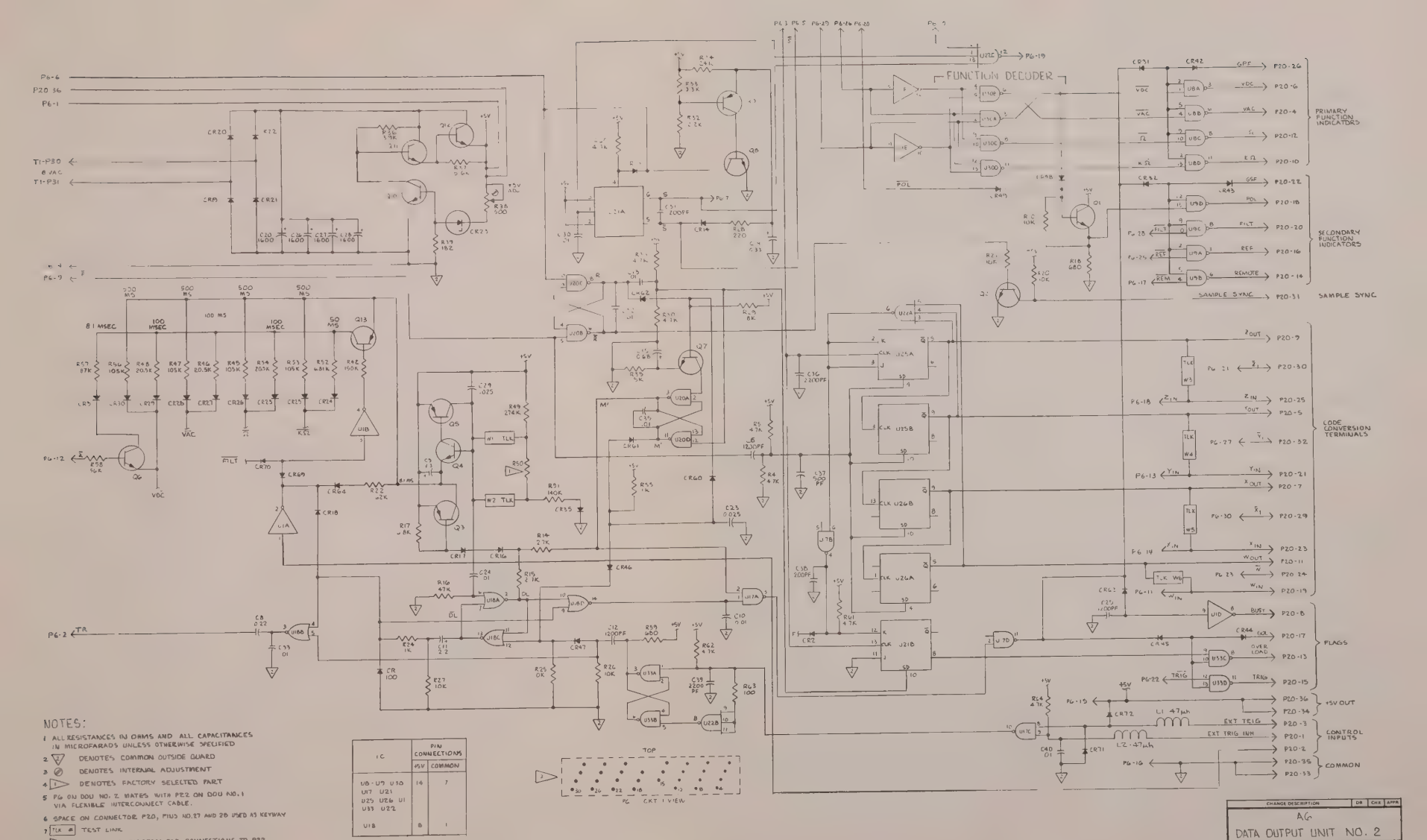


NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ▼ DENOTES LOGIC COMMON
3. ▽ DENOTES COMMON OUTSIDE GUARD
4. ▷ SIGNALS a, b, c, AR, REF, AND FIL CORRESPOND IN FUNCTION TO THOSE IN BASIC DVM, BUT ARE NOT IDENTICAL SIGNALS

IC	PIN CONNECTIONS	
	+5V	COMMON
U1 - U6	16	7
U8 - U10		
U12 - U15		
U7	16	8
J11	24	7

CHANGE DESCRIPTION	DR	CHK	APPR
A5 REMOTE CONTROL UNIT			
PART NO.	SIZE	DRAWING NO.	
	D	8375A-1011	
SCALE	SHT	OF	REV
			DIBY



IC	PIN CONNECTIONS	
	+5V	COMMON
U8-U7 U10 U11 U25 U26 U27 U33 U22	14	7
U18	8	1

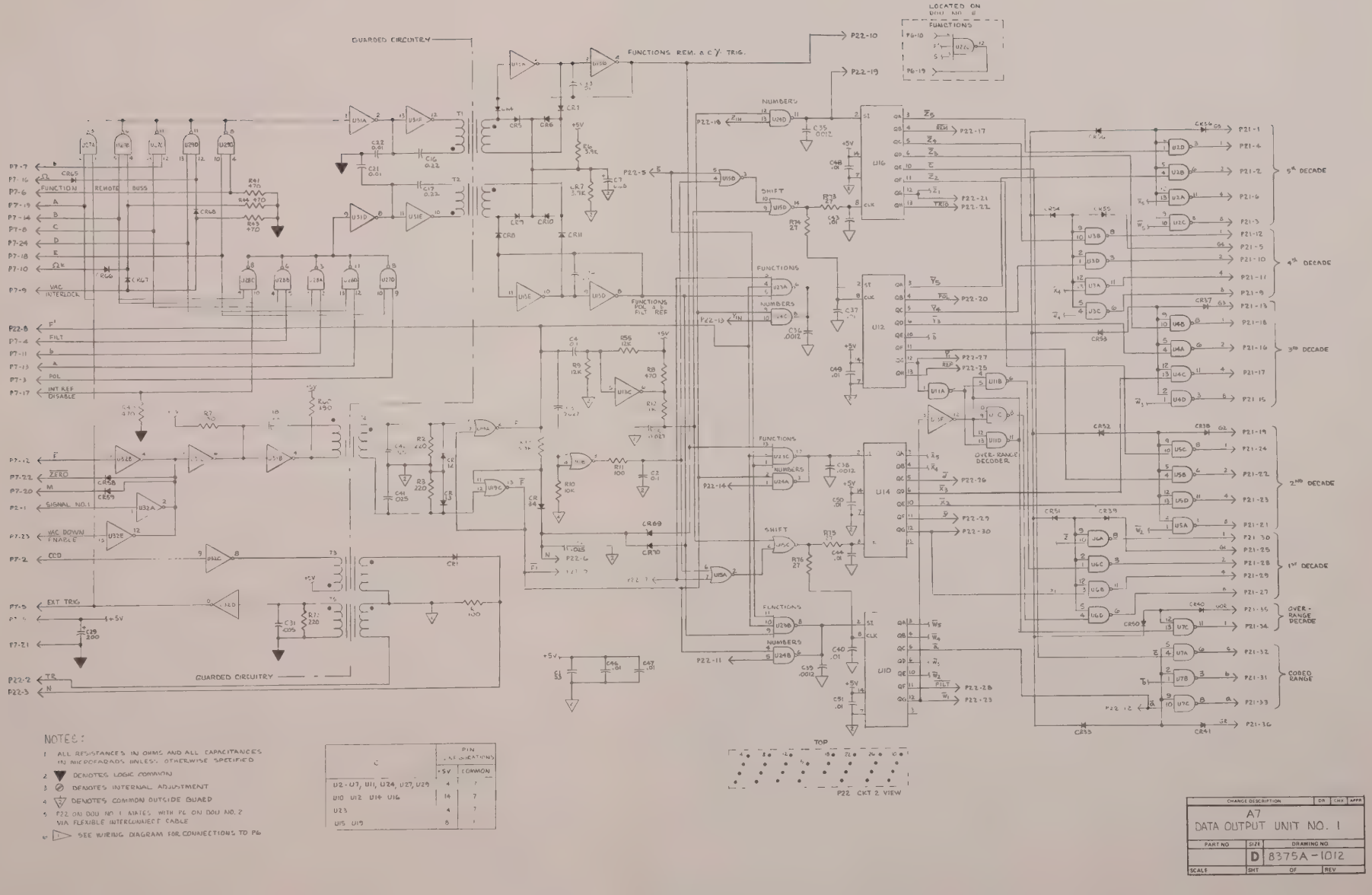
NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. DENOTES COMMON OUTSIDE GUARD
3. DENOTES INTERNAL ADJUSTMENT
4. DENOTES FACTORY SELECTED PART
5. P6 ON DOU NO. 2 MATES WITH P22 ON DOU NO. 1 VIA FLEXIBLE INTERCONNECT CABLE.
6. SPACE ON CONNECTOR P20, PINS NO. 27 AND 28 USED AS KEYWAY
7. TLK # TEST LINK
8. SEE WIRING DIAGRAM FOR CONNECTIONS TO P22

CHANGE DESCRIPTION	DR	CHK	APPR
AG			

DATA OUTPUT UNIT NO. 2

PART NO.	SIZE	DRAWING NO.
	D	8375A-1013
SCALE	SHT	OF REV
	DIST	



NOTES:

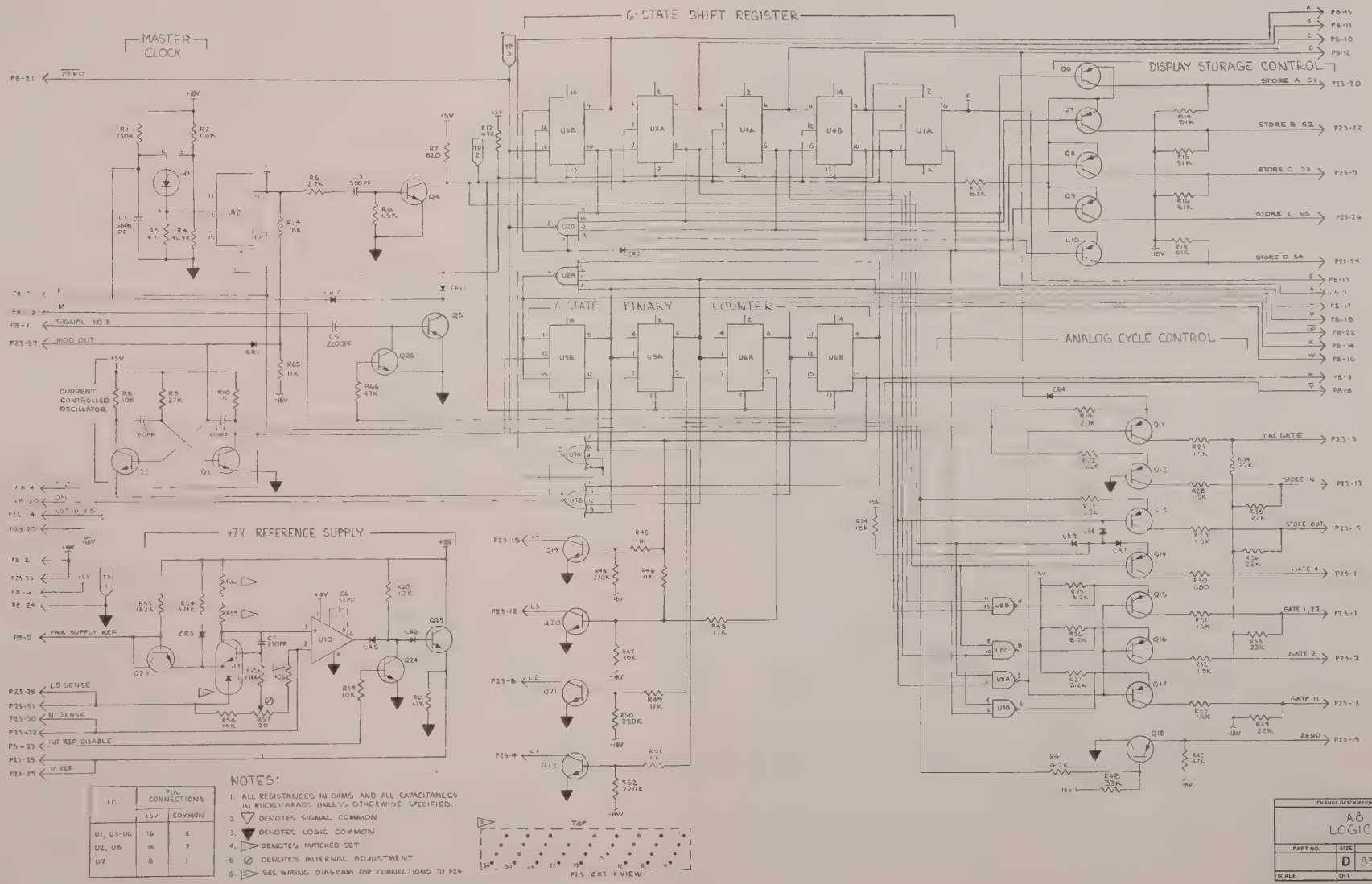
1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. ▼ DENOTES LOGIC COMMON
3. ⊘ DENOTES INTERNAL ADJUSTMENT
4. ▽ DENOTES COMMON OUTSIDE GUARD
5. P22 ON DOU NO. 1 MATES WITH P6 ON DOU NO. 2 VIA FLEXIBLE INTERCONNECT CABLE
6. (1) SEE WIRING DIAGRAM FOR CONNECTIONS TO P6

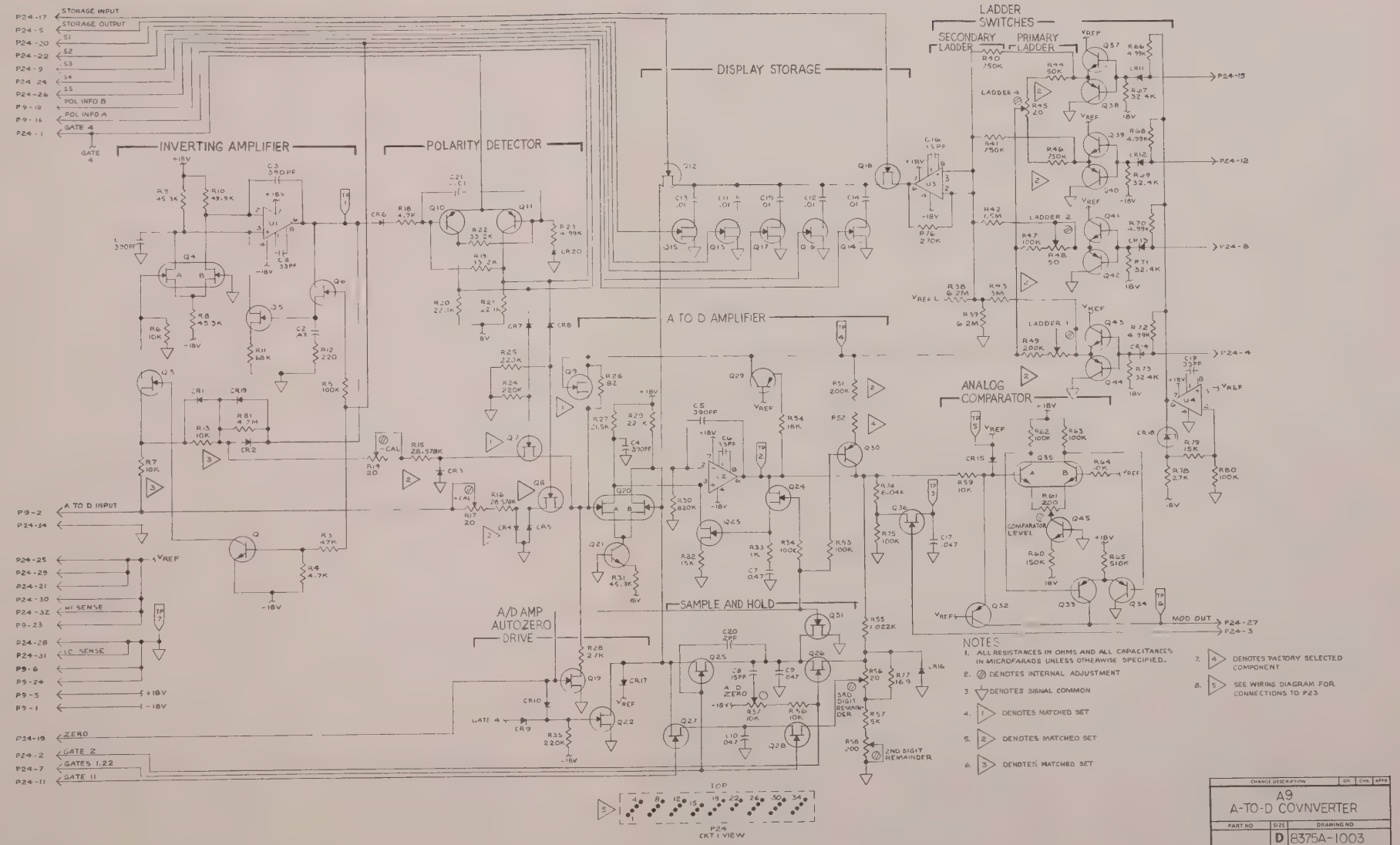
IC	PIN DESIGNATIONS	
	+5V	COMMON
U2-U7, U11, U24, U27, U29	4	7
U10 U12 U14 U16	14	7
U23	4	7
U15 U19	8	1

CHANGE DESCRIPTION	DR	CHK	APPR

A7
DATA OUTPUT UNIT NO. 1

PART NO	SIZE	DRAWING NO
	D	8375A-1012
SCALE	SHT	OF REV

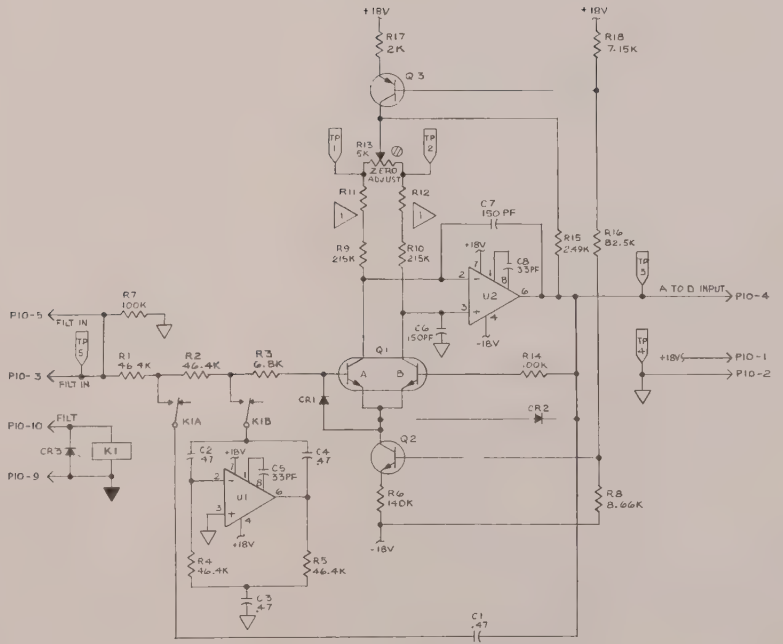

MASTER CLOCK
6-STATE SHIFT REGISTER
DISPLAY STORAGE CONTROL
ANALOG CYCLE CONTROL
6-STATE BINARY COUNTER
CURRENT CONTROLLED OSCILLATOR
+7V REFERENCE SUPPLY
ZERO
SIGNAL NO B
MOD OUT
PWR SUPPLY REF
LO SENSE
HI SENSE
INT REF DISABLE
V REF
STORE A S1
STORE B S2
STORE C S3
STORE E S5
STORE D S4
CAL GATE
STORE IN
STORE OUT
GATE 4
GATE 1,22
GATE 2
GATE 11
ZERO
NOTES:
1. ALL RESISTANCES IN OHMS, AND ALL CAPACITANCES IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
2. DENOTES SIGNAL COMMON
3. DENOTES LOGIC COMMON
4. DENOTES MATCHED SET
5. DENOTES INTERNAL ADJUSTMENT
6. SEE WIRING DIAGRAM FOR CONNECTIONS TO P24
IC
PIN CONNECTIONS
+5V
COMMON
U1, U3-U6
16
8
U2, U8
14
7
U7
8
1
TOP
P23 CKT I VIEW
CHANGE DESCRIPTION
DR
CHK
APPR
A8 LOGIC
PART NO.
SIZE
DRAWING NO.
D
8275A-1104
SCALE
SHT
OF
REV



CHANGE DESCRIPTION	DR	CHK	APPR

A9
A-TO-D COVNVERTER

PART NO	SIZE	DRAWING NO
	D	8375A-1003
SCALE	SHT	OF REV
	DIST	



NOTES

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ▽ DENOTES COMMON.
3. ▼ DENOTES LOGIC COMMON.
4. 1 FACTORY SELECTED
5. ⊘ DENOTES INTERNAL ADJUSTMENT

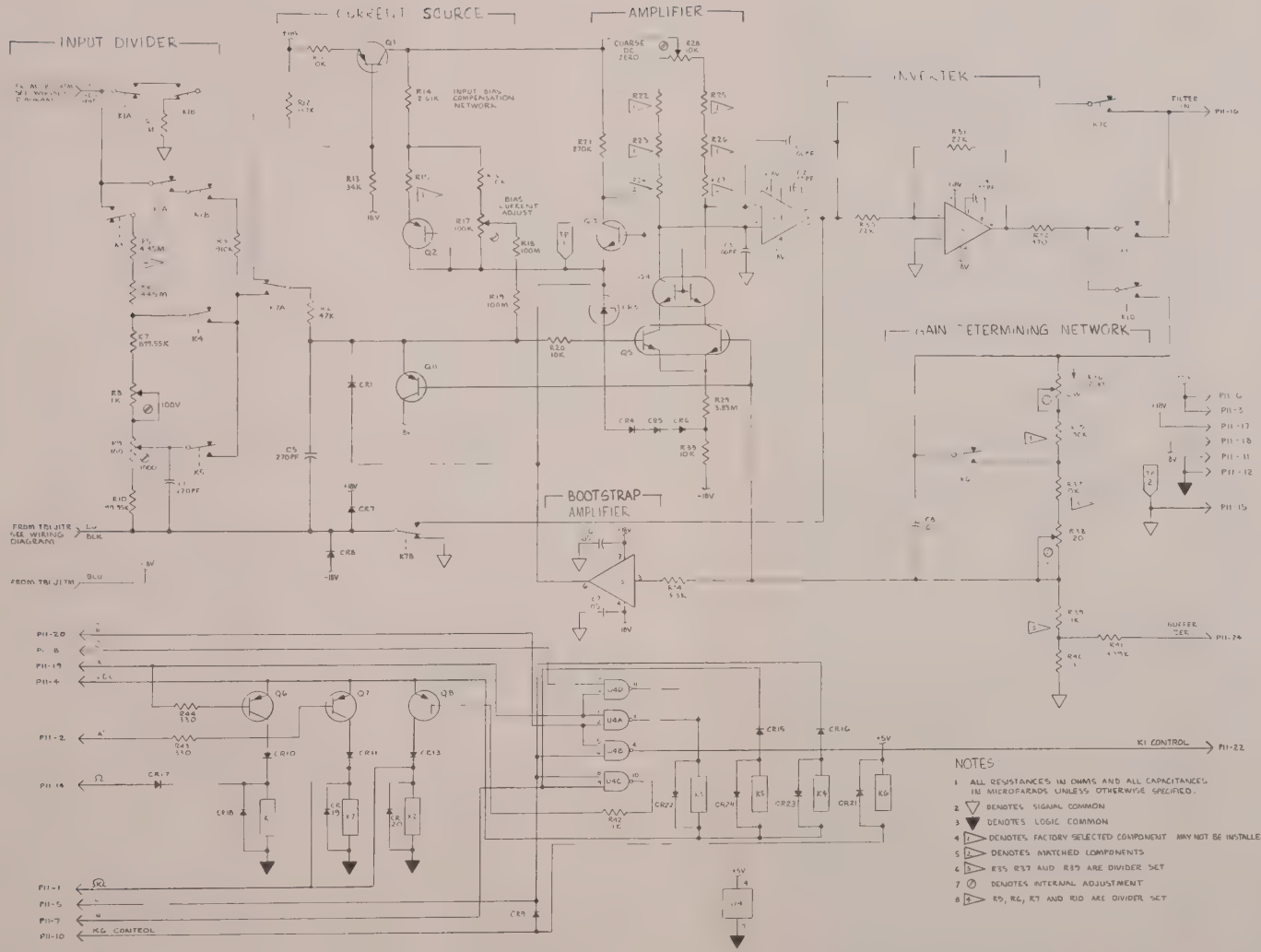
CHANGE DESCRIPTION	DR	CHK	APPR

A10
ACTIVE FILTER

PART NO	SIZE	DRAWING NO.
	D	8375A-1015

SCALE	SHT	OF	REV.

DIST



BUFFER RELAY LOGIC

	VOLTAGE RANGE				
	LO		HI		
RELAY	0.1	1.0	10	100	1000
K1	•	•			
K2			•		
K3				•	•
K4				•	
K5					•
K6	•				
K7		•	•		

• INDICATES RELAY ENERGIZED

NOTES

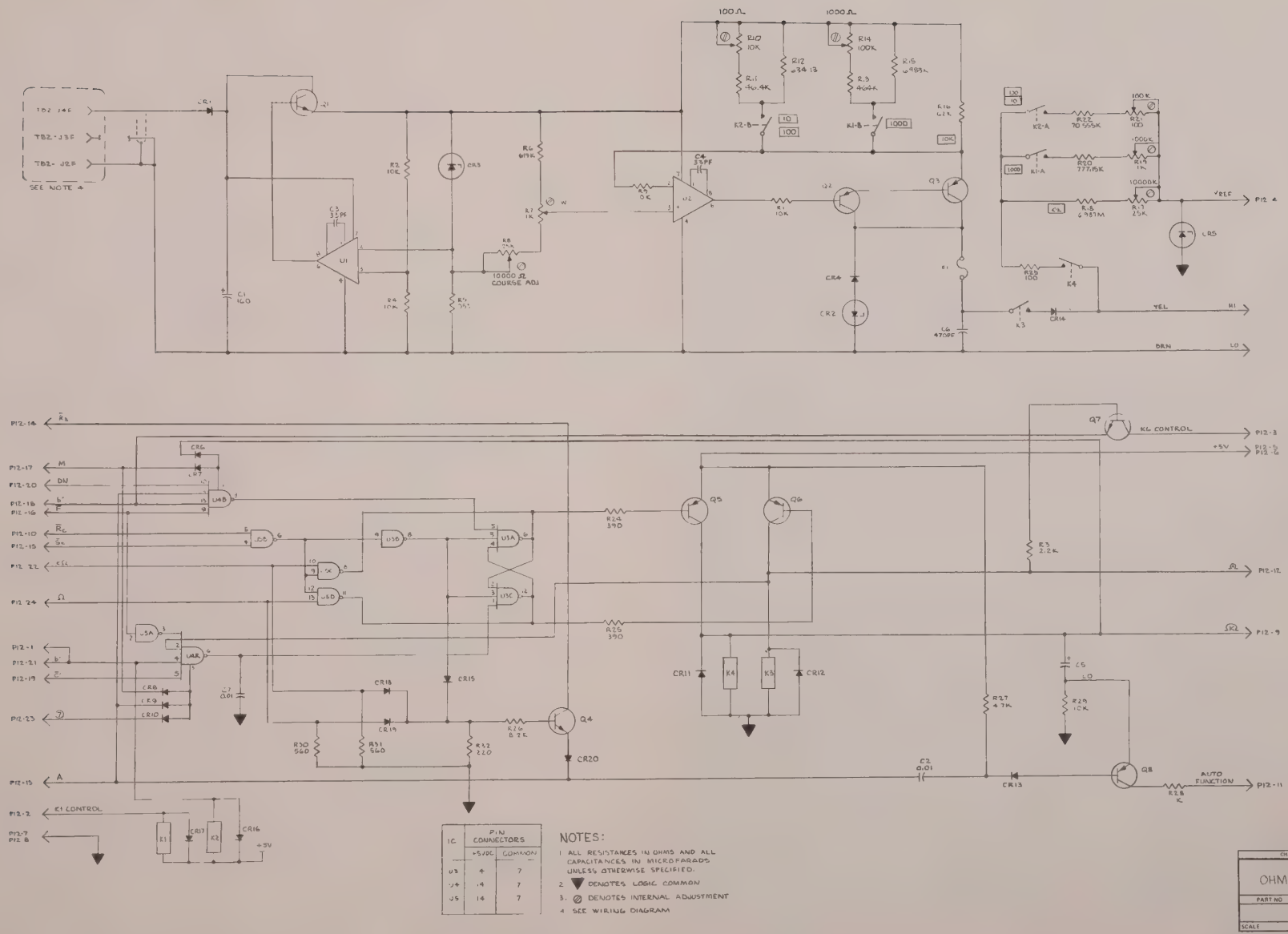
1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ▽ DENOTES SIGNAL COMMON
3. ▼ DENOTES LOGIC COMMON
4. △ DENOTES FACTORY SELECTED COMPONENT MAY NOT BE INSTALLED
5. △ DENOTES MATCHED COMPONENTS
6. △ R35 R37 AND R39 ARE DIVIDER SET
7. ⊘ DENOTES INTERNAL ADJUSTMENT
8. ◇ R5, R6, R7 AND R10 ARE DIVIDER SET

CHANGE DESCRIPTION	DR	CHK	APPR

A11
BUFFER

PART NO.	SIZE	DRAWING NO.
	D	8375A-1005

SCALE	SHT	OF	REV
			DIBY



I.C.	PIN CONNECTORS	
	+5 VDC	COMMON
U3	4	7
U4	14	7
U5	14	7

NOTES:

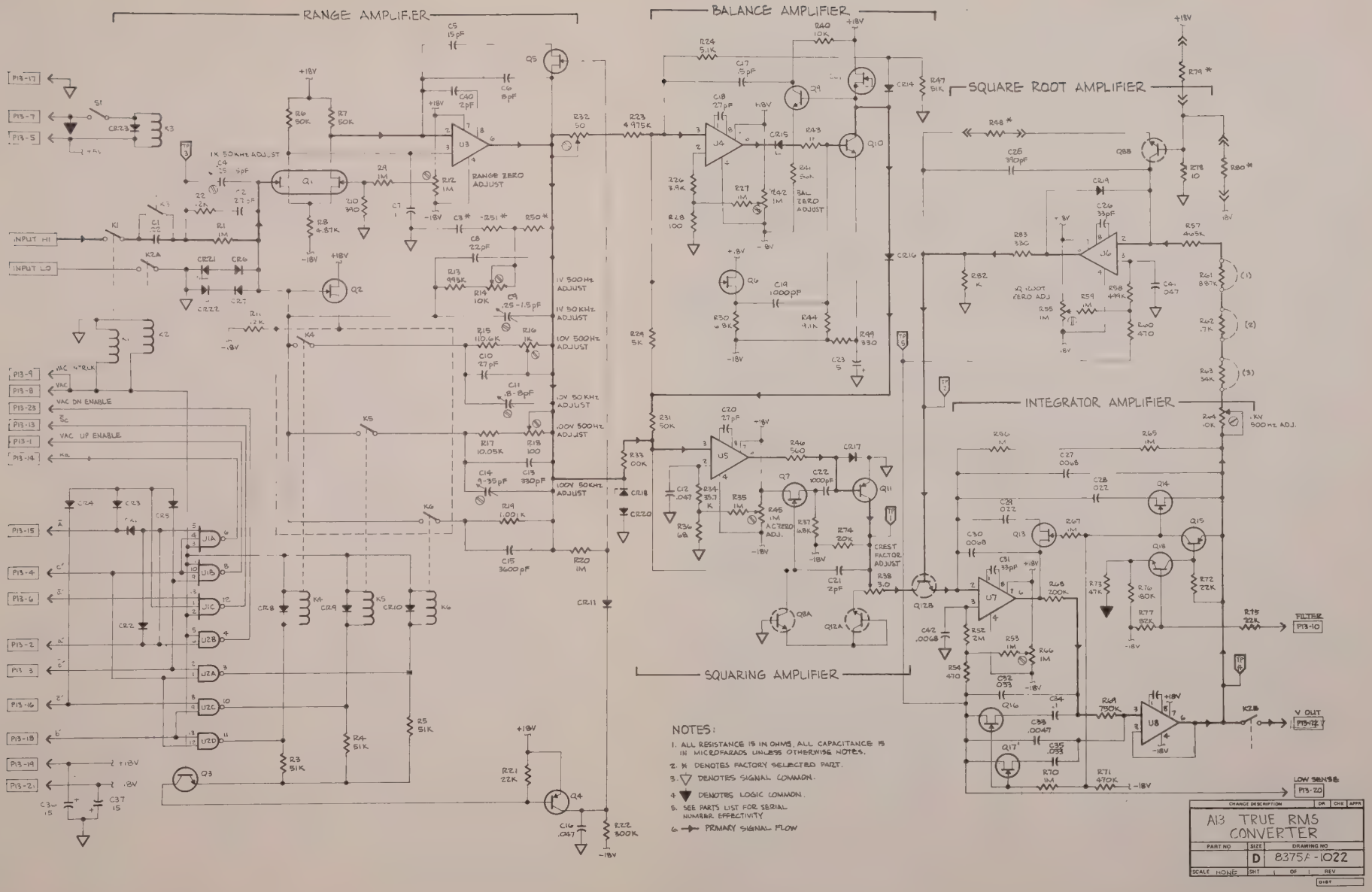
1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ▼ DENOTES LOGIC COMMON
3. ⊘ DENOTES INTERNAL ADJUSTMENT
4. SEE WIRING DIAGRAM

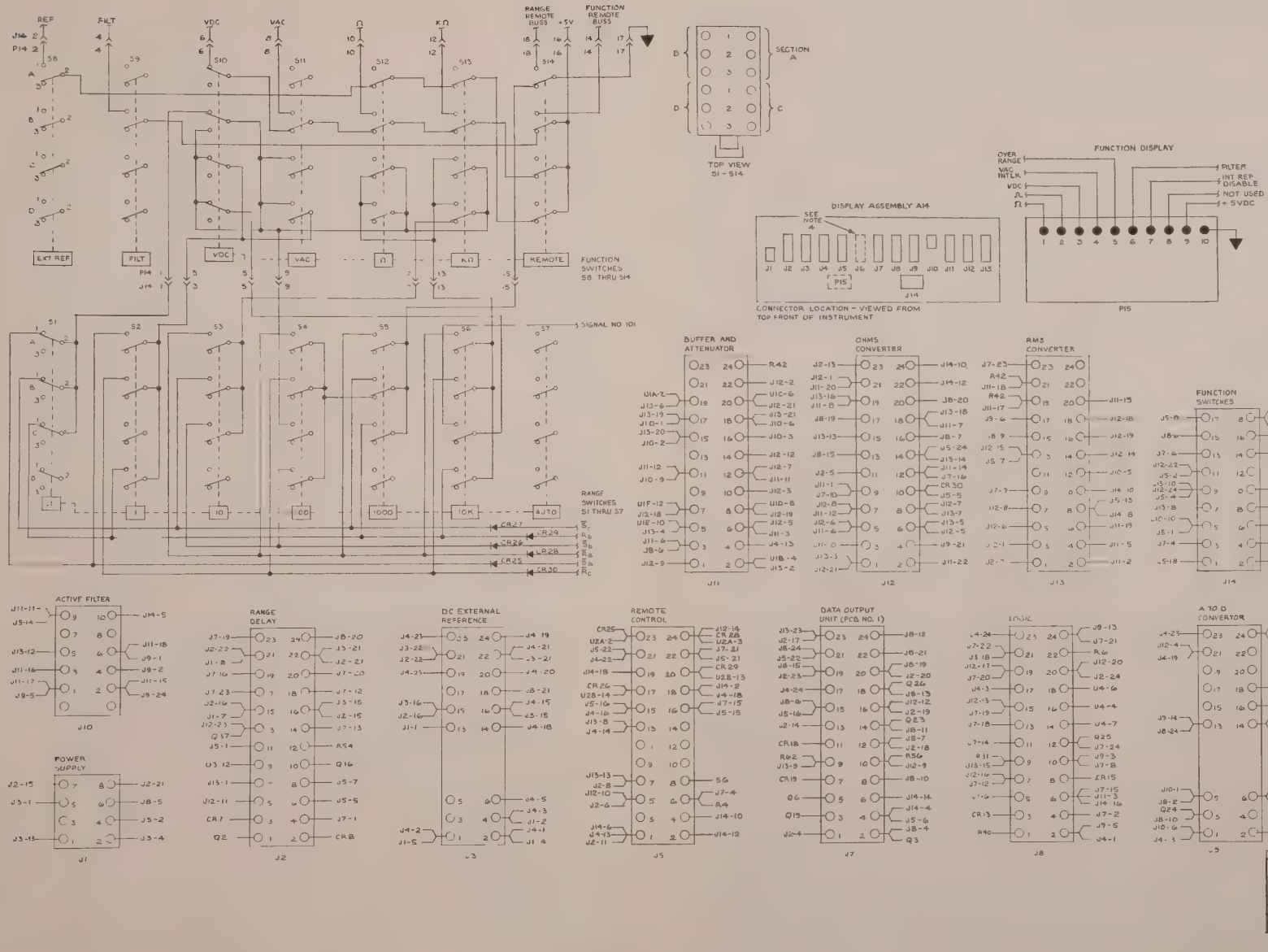
CHANGE DESCRIPTION	DR	CHK	APPR

A12
OHMS CONVERTER

PART NO	SIZE	DRAWING NO
	D	8375A-1010

SCALE	SHT	OF	REV


RANGE AMPLIFIER
BALANCE AMPLIFIER
SQUARE ROOT AMPLIFIER
INTEGRATOR AMPLIFIER
SQUARING AMPLIFIER
INPUT HI
INPUT LO
1K 50KHz ADJUST
RANGE ZERO ADJUST
BAL ZERO ADJUST
1V 500Hz ADJUST
1V 50KHz ADJUST
10V 500Hz ADJUST
10V 50KHz ADJUST
.00V 500Hz ADJUST
100V 50KHz ADJUST
VAC 47RLK
VAC
VAC DN ENABLE
VAC UP ENABLE
CREST FACTOR ADJUST
FILTER
V OUT
LOW SENSE
NOTES:
1. ALL RESISTANCE IS IN OHMS, ALL CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE NOTES.
2. * DENOTES FACTORY SELECTED PART.
3. ▽ DENOTES SIGNAL COMMON.
4. ▼ DENOTES LOGIC COMMON.
5. SEE PARTS LIST FOR SERIAL NUMBER EFFECTIVITY
6. → PRIMARY SIGNAL FLOW
A13 TRUE RMS CONVERTER
D
8375A-1022



NOTES:

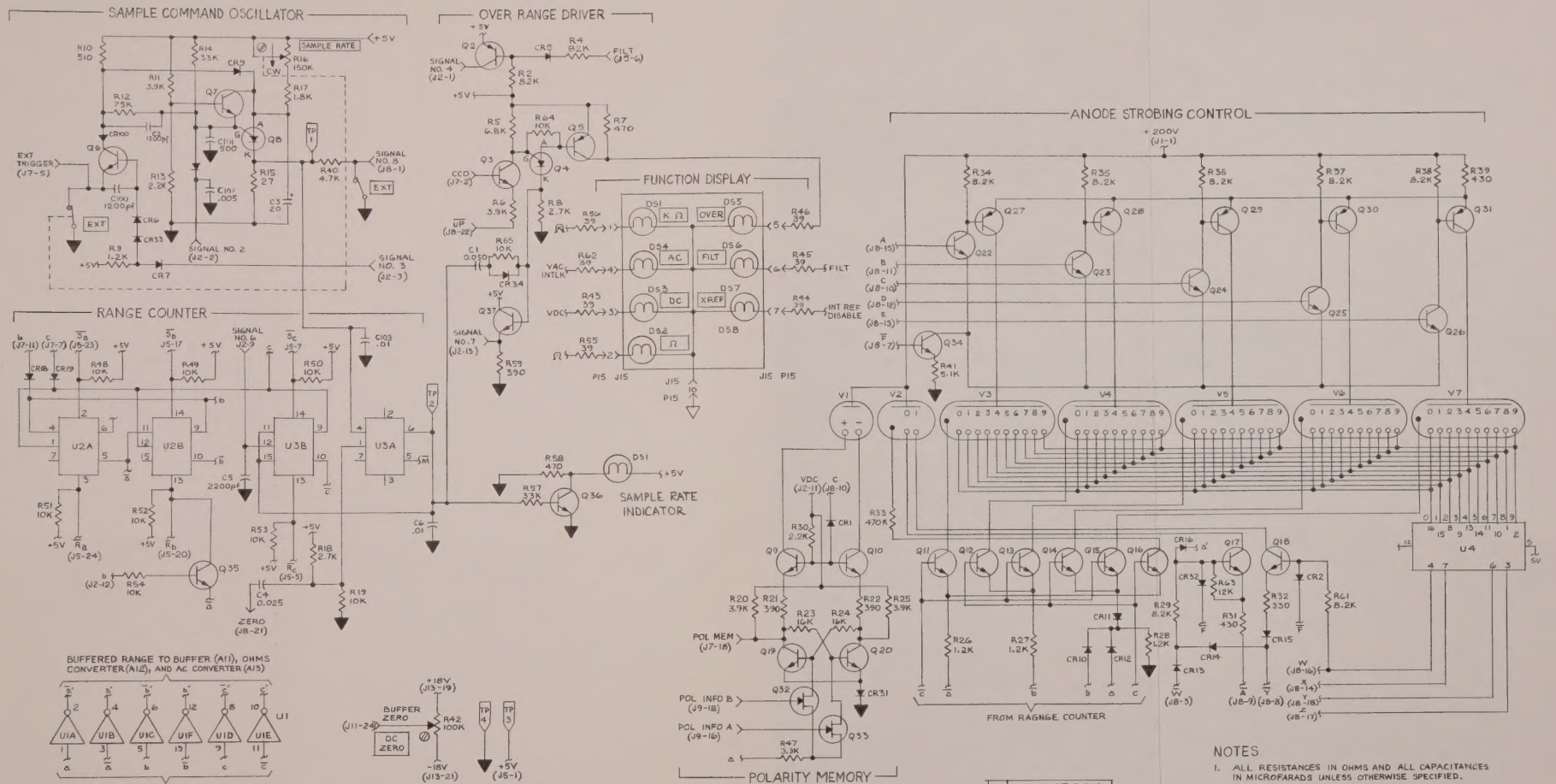
1. ▼ DENOTES LOGIC COMMON.
2. □ DENOTES FRONT PANEL LOCATION.
3. CONNECTORS J6, J22, J23, AND J24 MATE WITH P6, P22, P23, AND P24 RESPECTIVELY IN HARD-WIRED NON-SEPARABLE CONFIGURATION. SEE ASS'Y INTERCONNECT DIAGRAM.

CHANGE DESCRIPTION	DR	CHK	APPR

A14
DISPLAY

PART NO	SIZE	DRAWING NO
	D	8375A-1002
SCALE	SHT 1 OF 2	REV

DIST



IC	PIN CONNECTIONS	
	+5V	COMMON
U1	14	7
U2	16	8
U3	16	8
U4	5	12

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